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AND

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THE FOUNDRY TRADE JOURNAL,
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BRITISH FOUNDRYMEN'S ASSOCIATION.

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NOTES AND COMMENTS.

Gas v. Coke.

Sheffield, rightly regarded as the heart of the crucible steel industry, is world-famed for the excellency of its products; but great though its reputation in the trade may be, it is still divided within itself as to whether producer-gas firing, or coke heating is the more efficient and economical method for crucible steel melting.

As is well known, the major portion of Sheffield's crucible steel work is carried on after the method handed down by honoured predecessors—a method which has, at least, placed the industry in its present prominent position. The coke-hole furnace has for many years produced its steel in a manner very satisfactory to the user, and the industry is still being carried on successfully by a generation of men, who, benefiting by the experience of their fathers and the assistance of modern science, well uphold the city's proud claim. But with the advance of modern commerce and the accompanying insistent calls for economy, the coke-hole method has been brought face to face with a rival—the producer-gas-fired furnace. It can scarcely be said that the latter method has found favour with the old steel melter. Although he has frequently tried it, he is slow to acknowledge its superiority to, or even its equality with, the older process. This, of course, may be largely accounted for by the fact that not only is he prejudiced in favour of his own method, but he lacks the experience and acquaintanceship necessary for a just criticism. In connection with this, one may ask, "What is there to support the claims of economy and efficiency, which the gas-fired furnace puts forth?" First, there is the consumption of fuel, which is a great consideration; this is considerably less than in the coke method. At present there are something like 20 gas-fired crucible steel-melting furnaces at work in Sheffield, and the

consumption of fuel ranges from 20 cwts. to 60 cwts. of coal per ton of steel melted. This is certainly below the consumption of coke, which may be taken as between 50 cwts. and 80 cwts., according to the material being dealt with. Moreover, the relative cost of the two fuels adds materially to the difference, coal being little more than half the price of coke. A thoroughly modern gas furnace should melt an average steel with about 25 cwts., or with a fairly mild steel about 30 cwts.

In the numerous attempts made to introduce the gas regenerative furnace the difficulty of heating the entire crucible to the same temperature was all too prominent, the top being nearly always somewhat cooler than the bottom. This trouble has been overcome by really modern furnaces, but it is only natural that melters of the old school who have only had experience with the less perfect designs should revert to the former practice. As with every other manufacturing process, success can better be attained by men thoroughly conversant with the requirements of the case.

That gas-fired furnaces have often proved failures for crucible work cannot be denied; but in America they have met with such approval that they are now used almost exclusively, and Germany, too, has largely adopted the process. Whatever the merits of the respective processes may be, these countries have often been in a position to successfully compete with Sheffield for large orders, both from the Continent and England.

At the present time, when the margin of profit on crucible steel work is so narrowed, the economy in fuel, the absence of clinker on pots, and consequent saving in that direction, and the ease with which gas-firing can be regulated should prove attractive to manufacturers; but against these considerations must be set the higher cost of repairs to gas-fired plant, as compared with the coke-hole. Repairs to the former are not only expensive in themselves, but often entail prolonged idleness of the men; while the coke-hole may be built up and the steel be melting in it within a couple of days.

The opinion still held by many prominent men, that for certain classes of work the coke-hole is the superior method, is, no doubt, well grounded; but, at the same time, when we see some of the biggest and best firms in the country melting with gas-fired plant it may be safely assumed that under some conditions the advantages outweigh the disadvantages. The using of the coke method places the manufacturer more at the mercy of every market fluctuation in the price of that commodity, and consequently narrows his capacity to meet competition; while the fuel-cost of the gas-fired furnace, being proportionately less, is not so seriously influenced.

There is, undoubtedly, room for further consideration of both the processes mentioned, for the pre-eminence of one of our greatest industries is affected.

The Passing of a Pioneer.

It is with considerable regret that we have to record in our obituary notes the death of Dr. H. Clifton Sorby, for that gentleman's name stands prominent on the roll of those who, by conscientious devotion to scientific research, have both enriched and instructed the nation. Dr. Sorby came of a family which has been associated with Sheffield since the time of Henry VIII. He was born in 1826, his father being a member of the well-known firm of J. & H. Sorby, of Spital Hill, edge tool manufacturers. He became known in connection with scientific work before he had reached the age of twenty-one. He published his first paper, the subject being "Agricultural Chemistry," over fifty-two years ago, and since that time he has given us no fewer than a hundred and fifty publications on various topics connected with his investigations. Microscopical work has been his chief study, but he can scarcely be said to have specialised in any particular branch. His investigations on meteoric iron led him to prepare slightly etched sections of artificial irons and steels, and it was soon found that by studying these by means of illuminators contrived by himself and others, most important information could be gained so as to put our knowledge of iron and steel on an entirely new footing. As a direct result of these investigations we have the now familiar process of examination and analysis of iron and steel by micro-photographic means. Dr. Sorby read a paper on the subject, and exhibited microscopic photographs before the British Association at Bath in 1864; but though the specimens were often publicly exhibited and described, the subject attracted little notice for more than 20 years, when, at the request of the Iron and Steel Institute, he published a paper in 1887. The manner in which the method has since been applied for practical use fully demonstrates the

service which has been rendered to the iron and steel trades.

Mr. Buchanan and An Inferred Criticism.

Mr. R. Buchanan, the President of the Birmingham Branch of the British Foundrymen's Association, took the opportunity at the close of a lecture delivered to the Branch in the Birmingham Technical School, on March 28, to refer to a criticism of the Association by the FOUNDRY TRADE JOURNAL. He said: "It had been charged against the Foundrymen's Association that it had too slavishly followed the example of the Iron and Steel Institute, and that their papers were too professorial and academic, and were not sufficiently practical. It should surely be unnecessary to point out that all practical operations had a scientific basis, and if the forces and laws governing practical operations were understood, those operations were much more likely to lead to satisfactory results than when carried on in the absence of such knowledge. Those who neither knew nor cared to know the nature of pearlite or cementite, or to understand other seemingly abstruse matters put themselves on the same plane as those who neither knew nor cared to know how to read and write. They might as well agree that the man who could not read or write was the best judge as to the relative advantages of ignorance or knowledge of those subjects. It was obvious that the man who, feeling the limitations imposed by ignorance, had determined to get rid of those limitations by the acquisition of knowledge was in a much better position for sound judgment of the merits of a case than one who said he did not understand both sides of the question, yet was confident that his decision was wise and right. It seemed to be decided that not to know things was not a disadvantage. There was a Scotch proverb which said, "Can dae (do) is easily carried about."

"He hoped that in taking up that position it would not be supposed that they were putting on airs of superiority. They were, in fact, to use an old simile, children picking up very small pebbles on the shores of the great sea of knowledge. Nevertheless, those pebbles might go to form part of the foundation of a great and noble structure yet to be erected. They of the British Foundrymen's Association well knew that the work in hand was so great as to require all the help of the best men, and they therefore gladly welcomed to their meetings and membership the professors, scientific lecturers and gentlemen connected with the professions interested in founding. Their presence, while mutually helpful, brought them into touch with, and under the influence of, the life, thoughts, and ideas permeating the universities and technical colleges of the country. If such a policy was wrong, then the universities and technical colleges were in the wrong also. He thought they would agree that such a suggestion reduced to an absurdity the sneer regarding the professors."

Our Reply.

In so far as Mr. Buchanan infers a sneer on our part at the professor and the highly technical paper he is mistaken; we would be the last to deny that such papers are very necessary to the advance of foundry knowledge. Furthermore, we would accord, as we have always done, full appreciation to those who have given their time and research to the interests of the foundryman. But to pursue Mr. Buchanan's simile, while we are yet as children gathering pebbles of knowledge for a great future structure, there is still room for instruction regarding the method of building. The worker who stands in need of help and advice regarding the everyday procedure of his work is apt to give only slight attention to the valuable information offered by the scientist, if it is not accompanied by some help more immediately applicable. A comparison of the proceedings of the American Foundrymen's Association with those of the British Foundrymen's Association will illustrate the idea we wished to convey; the former Society, while according to the academic paper a deal of consideration, also presents information which is greatly helpful in foundry practice. The laboratory leads the worker to a fuller and more scientific comprehension of the matters with which he has to deal, and places him in a position of mastery over many problems which formerly were insurmountable. But, nevertheless, it must be admitted that laboratory knowledge does not cover the whole ground of foundry work. It is strange that the claims of practical and mechanical procedure should appear to imply a sneer at a branch dealing, to a great extent, with another side of the subject. Mr. Buchanan's own contention is for an understanding of both sides of the question. What we advocated was a more definite alliance of the scientific and the practical, which must necessarily be the basis of all true progress.

FOUNDRY PRACTICE, WITH SPECIAL REFERENCE TO MARINE WORK.*

By W. Dalrymple (Sunderland).

Having been invited to read a paper on "Foundry Practice" to the members of your Institution, I have selected an important section of the foundry work on the North-East Coast—I mean making castings for marine engines. The increased size of engines and the more exacting requirements of the marine engineer, coupled with the complicated designs and desire for lightness, has given the foundry master great anxiety in his work.

In the foundry the improvements have been more in the way of better crane power, grinding mills for sand and loam, than in moulding proper, though the transition from making large castings in loam to making them in dry sand has enabled the moulder to turn out the large castings in 25 per cent. less time than formerly, and at less cost.

In the case of dry sand moulding, strong cast-iron boxes, somewhat larger than the work to be moulded, are sunk into the floor of the foundry so that the top of the box is level with the foundry floor. These boxes, made strong at first, will last many years without needing to be replaced.

In loam moulding, a large bottom plate on wheels is the foundation on which the mould is built up. Strong rings, having prods cast on them, retain the bricks and loam with which the mould is built up; it is then wheeled into a stove or oven to be dried.

These stoves are a very important item in foundry equipment, and are made up to 36 ft. long, 24 ft. wide, and 9 ft. high, built of bricks, and have two large fireplaces holding about 12 cwts. of gas coke. When the moulds are wheeled in, the fires are lighted at night, the door closed and left until the next morning, when the moulds are dry, and are wheeled out of the stove ready for the moulders to work at. The size of the stove is fixed by the class of work to be dried; the above size would hold two of the largest propellers that are made solid. It is customary to set aside a part of the foundry solely to mould, dry, and cast propellers.

The foundry should be supplied with overhead cranes, steam or electric, with lifting power well above what may be required of them. Small jib cranes should be placed over the cylinder cases to enable the small cores to be handled without using the large cranes.

The ordinary pattern cupola that has been in use for generations seems to hold its own. A cupola with an internal diameter of 48 in., with a wind pressure of 21 in., will melt 30 tons in 5 hours, using 75 cwts. of coke, including bed charge; the same quantity of metal could be melted with less coke, but would take longer to do it, which is a mistaken economy. The coke should be of a good, sound, hard quality, and as little small put into the cupola as possible. After a bed charge of 15 cwts. has been lighted, then 30 cwts. of metal and 2 cwts. of coke, and so on alternately until after the last charge, when some left-off coke from previous day's melting is added.

Castings for marine engines are usually made in dry sand or loam; most of the moulds are made in dry sand, and the cores in loam. Cylinders, being the most important castings to occupy the attention of the moulder, only the best of the men are engaged on their manufacture.

The temperature at which castings are run has much to do with their solidity. Light castings should be poured as hot as convenient, while heavy castings should be poured when much cooler. At the present time, when we are not in a position to thrust a thermometer into the molten metal to note its temperature, we have to be content with the usual foundry terms, namely, "dull" and "very hot."

The shrinkage of castings is a very important matter, although the shrinkage of 20 bars, each 6 ft. long and 2 in. square, cast of various mixtures, did not vary more than one-sixteenth of an inch. The mixtures without steel did not shrink so much as that with steel in.

Unequal distribution of metal, especially in cylinder castings, gives trouble when under test pressure. Great care should be used in designing cylinders to avoid very thick parts in the castings.

The mixtures of metals used in a large foundry in the district are as follows:

For cylinders, 50 per cent. selected old or remelted metal, 20 per cent. Scotch, 30 per cent. Cleveland, No. 3 G.M.B.

For condensers, 50 per cent. selected scrap, 15 per cent. hematite, 15 per cent. Scotch, 20 per cent. Cleveland, No. 3 G.M.B.

Bedplates, pumps, and most other castings, equal parts of scrap metal and No. 3 G.M.B.

A good deal has been said and written

* Read March 9 before the Cleveland Institution of Engineers.

about the constituents in the pig-iron used in making castings, and suggestions made that all the materials be analysed. Unless this could be thoroughly done, which is almost an impossibility in a large foundry, it would be of very little use; as a matter of fact, all we can learn from foundries that have dabbled with chemists, is that the results are so different and irregular that it does not encourage others to go and do likewise. The latest we have on this subject is microscopic examination, which I hope will prove more useful than the chemical analysis.

Cylinders.

In starting to make a cylinder, what is called in the trade "a print" is swept; that is, a cast-iron plate, on which is swept a layer of loam, say, 3 in. thick, with a recess in the middle to receive either the cylinder pattern or a cope, representing the circular part of the cylinder. If a cope, this is built up in bricks and loam, swept up to the outside diameter of the cylinder and dried in the stove, so that the steam chests, etc., can be fixed against it. We have then a complete pattern to mould from (in the smaller cylinder a full wood pattern is supplied); this is put into a case or moulding-box, about 2 ft. larger and deeper than the pattern. The space between the pattern and the case is then rammed up with sand, and when rammed up to the top of pattern, a top box is put on to it, and this is rammed up from the top. Wooden gate sticks are placed in suitable position for running and feeding gates. A heavy plate is cast to carry the steamway and exhaust passage cores, and into this these cores are fixed securely on the floor.

After the top box is lifted off it is turned over for finishing, smoothed over with a trowel, and painted with a mixture of claywash and plumbago. It is then turned over again and thoroughly dried.

The pattern is now removed from the mould, and the mould smoothed, blacked and dried, after which the various cores are fixed, and the top box securely fixed to the bottom box or case by a number of bolts along the flanges of the case. After this, a runner or trough is fixed; this trough has a number of holes through it corresponding to the holes found in the mould, by which the metal is poured into the mould. There is also provision made on the top for feeding gates, which should be kept open so long as ever the metal is molten.

The runner should be as high above the mould as is reasonably safe, so as to have as much pressure on the mould as possible. A safe way to run the metal into the mould is to have a large gate with branches attached to the steam chest flanges near the bottom, so that the mould is filled from the bottom.

In some cases cylinders are cast close end down; this entails extra work, also a head on top of flange. This method ensures the cylinder bottom being sound when under water pressure, but perhaps the top flange is not quite so sound as when cast the other way.

A large cylinder should be left in the mould four days to cool before being lifted. The cores are then taken out, the gates and other rough parts dressed and made ready for despatch.

Condenser.

The quickest way to mould a rectangular condenser is to have a full pattern and complete set of core-boxes. The mould is made in dry sand by sand moulders; the column parts are made loose so that they can be placed on beds prepared for them by ramming that part of the mould and making it straight and level. When the columns are properly placed, the body pattern is fixed to them.

The box in which the condenser has to be made should be at least 2 ft. longer and wider than the pattern; having placed the pattern on the beds, weights are put on to prevent it rising while being rammed up. As most condensers have a half-round top, the mould is rammed up to the centre of pattern, and then drawbacks, that is, loose pieces of metal, with lifting eyes cast in, are placed in position, and the mould rammed up to the top of box. Light cast-iron grates with staples cast in to secure them to the top box are laid over the body part, then the top box is put on. The staples being long enough to come through are made secure, and the top box is rammed up solid.

The top part of column is carried by plates, and is lifted off separately from the top box. When the top box and column plates have been lifted off, they are turned upside down to have pieces of the pattern removed, and are dressed smooth, dried, and blacked ready to be put on to the mould; the pattern is then drawn out of the sand and the mould smoothed, dried, and blacked ready to receive the cores which have been proceeded with on the loam floor by the

loam-moulders. The core for a condenser, say, 15 tons weight, is no mean construction; it may be 16 ft. long, and with bars, grates, bricks, loam, and ashes will weigh about 10 tons before being dried. It will be seen that to support this weight the bars to carry the core will have to be very strong. When all has been thoroughly dried, the main core is put into its place and the column cores properly fixed. The mould is now ready for closing up; the top box and column covers are put on and secured by bars and bolts. A condenser of the dimensions given would require weights or bolts equal to 40 tons to hold it safely and prevent the liquid metal leaking through the joint between the bottom case and top box.

After these preliminaries, two runners or troughs for distributing the metal would be fixed over the gates provided to fill the mould. In this case, there would be six gates going down to the ends of the three columns, and six or more small gates going to the bottom of condenser.

A 12- and a 10-ton ladle would be filled nearly full of hot metal, and the metal would be poured into the runners.

The mixture for a large condenser would be about 50 per cent. selected old metal, 15 per cent. hematite, 15 per cent. Scotch, and 20 per cent. Cleveland No. 3 G.M.B.

Part of the main core has to be removed within a few hours after pouring to allow the casting to shrink, otherwise it would split in cooling. A condenser this weight ought to be left at least four days in the mould before being lifted. It is then lifted, the superfluous sand taken off, the casting dressed, that is, the gates and any other roughness chipped off, and is ready for despatch in four weeks from being commenced. Great care has to be taken to ensure the mould and cores being thoroughly dried, as a little damp would spoil the result.

Small condensers are usually made in loam, when the loam-moulders make the mould as well as the cores.

Bedplate.

Marine engine bedplates are made in one, two, or three parts, according to the facilities for machining or the orders of the buyers; the procedure of moulding is practically the same in each.

In this case a full pattern and core-boxes are provided; the mould is prepared by ramming up beds straight and level for the pattern to rest on; the pattern is now set in these beds and weighted down to prevent it rising when the mould is being rammed up. Large plates with long staples cast in are placed a little below and between the bridges or "hobbies," so that part of the mould can be lifted out after the pattern has been drawn to allow the moulders to get into the mould to dress and finish it. The pattern is now drawn out, then the quarters lifted out. The top box is put on and rammed up, and suitable runner gates formed. It is now ready for lifting off to be smoothed, dried, and blacked.

The mould has to be dried with coke fires, after which it is painted over with plumbago. The quarters, that is, the parts that have been lifted out between the bridges, are dealt with in a similar manner. The mould is now ready to receive the cores which have been made by the loam-moulders of sand, bricks, ashes, and cast-iron grates, or frames, to enable them to be lifted by cranes into the mould.

The mould is now ready to receive the cores; each core has to be vented, that is, pipes have to be fixed to carry off the gases formed by action of the hot metal on the cores. If this is not thoroughly done, gases may accumulate and explode, forcing the hot metal up through the gates and spoiling the casting. The mould is filled in 1½ minutes. The sand in spaces between the bridges has to be eased to allow the casting to shrink. It is necessary in some bedplates to lift them bodily out of the sand to allow equal cooling. A bedplate 10 tons weight can be cast, dressed, and despatched in two or three weeks.

Propeller.

A most important part of a steamer's equipment is the propeller. We have not to go into the theories of propellers, but rather to begin where the designer leaves off. The drawing of the propeller is sent to the pattern-shop, where the pitch and angles are drawn down full size. A strong plate, about 3 ft. larger in diameter than the outside size of the propeller, has to be provided. This plate, in most cases, is mounted on wheels so that it can be run in and out of a stove or large oven. With propellers of a design requiring a separate angle about every foot along the blade, these angles are made of light iron, as they have to be drawn out of the mould before it goes to the stove. Most propellers have only one angle placed close to the boss and one at the outside diameter of the blade, the space between being

strickled off with a straight-edge. The next operation is to sweep a cup, that is, a cup-shaped mould, to form the bottom part of the propeller boss, also a recess to guide the lower end of the centre core.

The plate that this cup is swept on has a turned spindle with a taper end fitting into a hole in the plate. The spindle is long enough to reach about a foot above the boss. A long straight-edge is clamped on to the upper part of the spindle, from which the boss is swept on. The angles are now placed on these seatings, and bricks built up with loam for a mortar nearly up to the line of the angles. Loam is put on and worked up to the top of the angles; this forms what moulders call the "bed." The whole structure is now put into the stove, and remains long enough to dry the bed. It is then brought out of the stove for the second operation, commencing with an examination by the pitchometer of the bed to make sure the surface is correct. This having been done, the shape of the blade is marked on, and strips of thin wood are placed in the bed to show the thickness that the blade is required to be. The spaces between these strips are filled up with sand and beaten solid. We have now the pattern in sand of the blade. Ribs or bars are then placed over the blades concentrically, and flat bars placed radially over these ribs, leaving a space of 2 in. to be filled up with loam; this is called covering. This done, the mould is put into the stove a second time to dry. The "blacking" operation consists of lifting the framework or quarters, removing the sand pattern, smoothing and blacking, or painting with plumbago, the quarters and bed. The quarters are now put back to their place, leaving a space of 4 in. between them and the beds; the mould is put into the stove for the third time and thoroughly dried. It is then brought out, and the quarters put into their places, the centre core put in, and all cramped down securely. A runner is placed on top of the boss, and the mould is ready for the metal.

It takes about 1½ minutes to fill a 7-ton propeller. A casting this size should be allowed to remain on its bed at least three days to cool before being lifted. It is then taken to the cleaners or dressers.

Air and Circulating Pump.

A full pattern and core-boxes are made for this casting. The moulder sweeps a level bed on a plate mounted on wheels; pattern is placed on this bed, and the mould is built up with bricks, having cast-iron binders or frames to bind the mould together. When built up to the top, it is wheeled into the stove to be partially dried. Meanwhile, cores have been made and are in process of drying; the mould is now taken to pieces, the pattern liberated, the mould smoothed and washed over with plumbago, and again wheeled into the stove to be thoroughly dried. When this is done, the cores are fixed in position, and the mould is ready for casting. I may say that this is the most expensive casting to make among the principal castings in a marine engine.

Discussion.

In the discussion, Mr. H. B. Toy, while praising the paper, said there were some points in it from which he differed. Thus, it was stated that the ordinary cupola pattern which had been in use for generations seemed to hold its own. He did not dispute the fact that 30 tons of metal could be melted in five hours using 75 cwts. of coke, but that depended very much on the character of the pig-iron which was used, especially on the amount of carbon, etc., which it contained. He believed that the harder the iron the greater would be the amount of contraction. He was in favour of using a pyrometer to ascertain the temperature of the metal with which he was dealing, and he did not think that the casting of iron was quite so simple an undertaking as the author would make out. He was surprised to hear him in these days speak disparagingly of the chemist. Scarcely anyone now depreciated the value of chemical knowledge in any branch of the iron and steel industries. He did not think the chemists would relieve founders of all their troubles, but they would guide them to a judicious blending of the materials that were used.

Mr. F. P. Wilson remarked that with reference to shrinkage he had learnt that a process had been brought to this country by a foreign gentleman which practically did away with all shrinkage. The moulds were made entirely of iron. He was able to turn a casting out of a mould in a few minutes without any shrinkage whatever. With respect to the assistance of chemists, he did not believe that they would help by their advice and analyses to make all castings good. Some founders were not in a position to carry out all the advice of the chemists, and make their practice an ideal one. When

they got bad castings, however, they often went to the chemist to find out why. They should go to him beforehand, so as to avoid making such castings.

Mr. E. Adamson spoke in favour of using a pyrometer, and mentioned the "Wanner" instrument as being a very good one. He was afraid Mr. Dalrymple had made a great mistake in having nothing to do with the chemist. He (Mr. Dalrymple) had really had no experience of chemists, and should not condemn the whole lot. Pure chemistry, however, he would acknowledge, was of no use to the ironfounder. He considered that Mr. Dalrymple has been rather too sweeping about chemists, but what they wanted at foundries was what the Americans called a metallurgical engineer.

Mr. Dalrymple was thanked for his paper, and his reply to the discussion is to be handed in in writing.

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The Philadelphia Foundrymen's Association.—The monthly meeting was held on March 4. Thomas Devlin, President, occupied the chair. An open discussion by the members on the business situation was substituted, and the consensus of opinion was that there had been some improvement in the situation in the past month. While plants were in almost every case running far below normal, gains in the number of orders were to be noted. The tendency of some foundrymen to reduce prices was deplored, as it was said that there was no reason for any decline. Plants were stated to be running at varying rates of activity, ranging from 35 to 65 per cent. of the production at the corresponding time last year.

MALLEABLE CAST IRON: ITS EVOLUTION AND PRESENT POSITION IN THE METALLURGICAL WORLD.*

By W. H. Hatfield.

A short time ago the Council of the Iron and Steel Institute issued their "Nomenclature of Iron and Steel," which contained the following definition of "Malleable Cast Iron":—

"Malleable cast iron is iron which when first made is cast in the condition of cast iron, and is made malleable by subsequent treatment without fusion. Although the English name of this variety suggests that it is cast iron, it is not truly a variety of cast iron, because it lacks the essential property of cast iron, viz., its extreme brittleness."

Fig. 1.

Fig. 2.

Tests of Malleable Iron Castings.

To say that this material lacks the extreme brittleness of cast iron hardly does it justice, and going further into the above definition the author ventures to suggest that malleable cast iron is truly a variety of cast iron, having all the advantages of such a casting with none of its disadvantages.

Fig. 1 shows the cold bending and twisting tests performed upon standard test bars, while Fig. 2 illustrates the malleability of castings of this material.

The object of this paper is to endeavour to raise malleable cast iron to that position to which it is now justly entitled both by its physical properties and its very general usefulness. The author has for some years been working upon the

* Abstract of Paper read, March 17, before the Institution of Engineers and Shipbuilders in Scotland.

scientific production of this material, and some of the results obtained will be referred to later.

The better to make clear the subsequent points, it is proposed as a preliminary to study the evolution of the malleable casting, which owes its existence in the first place to the art of moulding, and in the second place to the science of metallurgy.

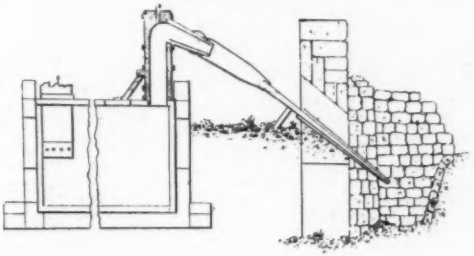
The art of moulding is considerably older than the science of casting iron. Samples of fine bronze castings are in existence made many centuries previous to the use of cast iron itself. To the excellence in the art of founding attained by the ancients the bronze replicas of their sculptures testify. A casting in iron could until very recently only be made when the iron approached in composition to that of the various pig-irons of to-day. The melting point is the determining factor, and the following table gives the comparative melting points of various metals :—

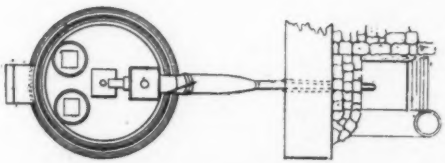
	Degrees. Cent.
Platinum	1750
Pure carbonless iron ...	1600 (about)
Steel (1.45% carbon) ...	1425 (about)
Pig-iron (3.80 % carbon)	1150 (about)
Copper	1084
Gold	1064
Silver	962

The iron produced in early times was relatively pure, and owing to the extreme heat required to reach its melting point, our ancestors did not successfully accomplish the casting, and hence the art of the blacksmith of forging wrought iron was so superbly developed. It will therefore be seen that until the more easily fusible irons were produced, the work of founding in iron could not flourish.

It is proposed now to trace the evolution of the modern blast furnace—in which is made the pig-iron from which both cast iron and malleable cast iron are produced—from the methods employed by the early races of mankind, which ancient methods are still prevalent in some of those countries into which modern civilisation has not penetrated.

ELEVATION.





PLAN.

FIG. 3.—THE CATALAN FORGE.

The method employed by the Celts on the Cheviot Hills previous to the Roman invasion was practically identical with that at present employed by the native African tribes on the banks of the Zambesi. Man very early learned that a lump of iron ore in contact with the fuel of a fire became so reduced to the metallic condition that he could forge it to a useful purpose.

A similar rudimentary method of extracting iron in its malleable condition seems to have been at work amongst most primitive peoples. In order that they might take advantage of the prevailing winds, small hearths were placed at the top of wind-swept gulleys, and with this

natural draft and charcoal fuel the crude smelting was done. By such means a piece of iron was prepared direct from the ore and could be forged into the various forms either for domestic or warlike purposes. This rudimentary direct reduction of the ore developed in different countries and in a remarkably similar manner. The first development was, of course, the substitution of a form of bellows (usually made of the skin of an animal) for the winds, and subsequently such ingenious devices as the foot bellows of India and the box bellows of China were evolved. A method displaying considerable ingenuity in the application of the blast has been in use, from very early times, at Orissa, in Lower Bengal. The crucible and tray used consist of ferruginous sandy soil, moistened and kneaded on to a skeleton of flexible wood. This furnace produces small "blooms" of wrought iron, and a distinctive feature is the ingenious way in which the blast is applied. The metal is taken out at the tuyere hole, and from another hole at the side the slag is run off. The tuyeres, strange to say, are of bamboo.

Amongst the earlier European developments was the Catalan forge, Fig. 3, in which malleable iron was produced. This furnace held its own in Western Europe down to a very late period. It consists, as will be seen, of a four-sided cavity or hearth into which the charcoal and iron ore are fed. The drawing shows how the blast is introduced through one tuyere. The main feature again is the method by which the blast is produced; in this case, by an apparatus invented in early times by an Italian. It consists of inducing the air by means of falling water.

The next development is the Osmund furnace, Fig. 4, which is really a large Catalan forge. The Stuckofen, Fig. 5, is the last furnace in which a malleable iron is produced directly from the ore, and it would be well to compare carefully the section of this furnace with the section of the Osmund. It will be seen that it is the Osmund furnace with the addition of a truncated cone of masonry. This increased height, by increasing the time in which the iron is in contact with the fuel, produced occasionally, and one might almost say accidentally, the first cast iron. The modern blast furnace owes its origin to this simple Stuckofen, and to the ingenuity of engineers in providing the gradually increasing motive power required for producing the necessarily increased blast.

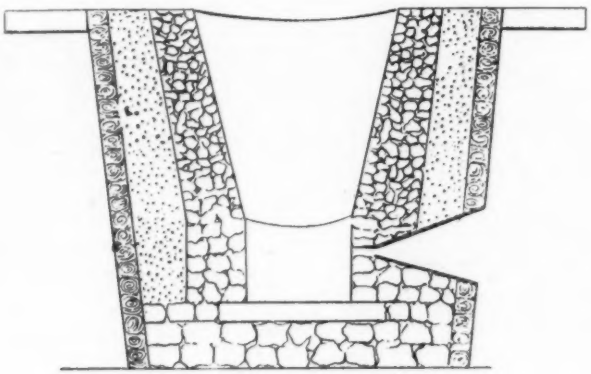


FIG. 4.—THE OSMUND FURNACE: SECTION.

Having obtained pig-iron, it can be conveniently cast into all sizes and configurations for industrial purposes, and as all malleable cast iron processes are commenced by making cast iron, it will be seen that a period is now being reached when this material came into existence.

As early as the fourteenth century there is evidence of cast iron being used in this country, but it was in the sixteenth century that the industry of iron-founding began to flourish, and guns and large castings began to be made.

The first description of the method of making cast iron malleable is due to

Reaumur. He published in 1722 "the fact that the heating of cast iron castings embedded in red oxide of iron softens the metal perfectly, and much more rapidly than all the other matters which he had tried." Practically the identical method described by Reaumur is at the present time in operation, and is producing a large quantity of the malleable cast iron consumed in this country. It is strange that Samuel Lucas should have been allowed to patent in 1804 a process which obviously was so well known practically a hundred years previously, but such is the case.

Of later date there has been developed another process for making malleable cast iron, which is called in America the "black heart" process. Before going into the difference in the two varieties

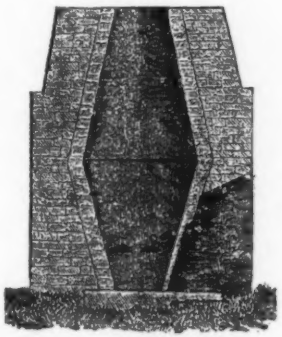


FIG. 5.—THE STUCKOFEN FURNACE: SECTION.

produced, it might be well to describe what malleable cast iron really is. It consists of castings made by melting suitable pig-iron and casting it into the required forms, which castings are, of course, annealed in order to produce the requisite malleability. The finished article, if successfully manufactured, possesses all the advantages of cast iron in that the low-melting point of the pig-iron allows the most intricate and difficult casting to be made, and these castings have the same beautiful skin and finish for which cast iron is so well known. As a further fact, it may be said that this material is practically free from blow holes, the composition of it ensuring the perfect occlusion of the gases which in a steel casting very often cause so much trouble. As regards the physical properties, it is malleable and ductile, and is easy to work in the machine shop.

All malleable cast iron when cast is identical in analysis with some variety of pig-iron, it having present in its composition from 3 to 4 per cent. of combined carbon, which gives to it that intense hardness which is found in the unannealed casting. The malleablising of the material is done either by the oxidation and elimination of the carbon or by precipitating it into such a condition that it does not militate against the production of the qualities desired.

Certain specific conditions are, of course, necessary for the production of this material when the carbon is merely changed in form, and as the irons from which the malleable castings in this country and Europe are made are generally extremely high in sulphur, not being able to change the form, manufacturers in the past have had to eliminate the

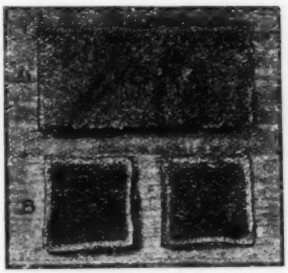


FIG. 6.—FRACTURES OF REAUMUR AND "BLACK HEART" MALLEABLE IRON.
A=REAUMUR, B="BLACK HEART."

carbon. Consequently, the method employed is that of Reaumur, namely, packing the castings with iron ore which oxidises and eliminates the carbon to such an extent that the casting attains that degree of malleability which is desired, the fracture of such casting being very similar to that of steel.

The malleable castings produced in America are of the black heart variety, and, generally speaking, the American process consists of precipitating the carbon and not eliminating it. These are castings which, in the finished state, have the same composition as pig-iron, and which bend double and fulfil the most stringent malleable cast iron specifications. Owing to the natural resources of America producing a pure iron with very little sulphur, the secrets of the manufacture of black heart castings were

quickly learned, and it is interesting to trace the rapid growth of this industry which to-day produces from 700,000 to 1,000,000 tons of malleable castings per year. In the early days of the last century, Seth Boyden, in Newark, New Jersey, U.S.A., laid the foundations of this enormous trade.

In the first place, the iron in both the American malleable processes and the European was melted in the crucible; the next stage was to melt this iron in cupolas as bigger quantities were required, and as purity became more essential the reverberatory and the open-hearth furnaces came into play. The methods of annealing, of course, have been considerably improved, but it is not my intention to go into details of the manufacture of this material, but to illustrate by means of photomicrographs the capability and constitution of these two varieties of malleable cast iron.

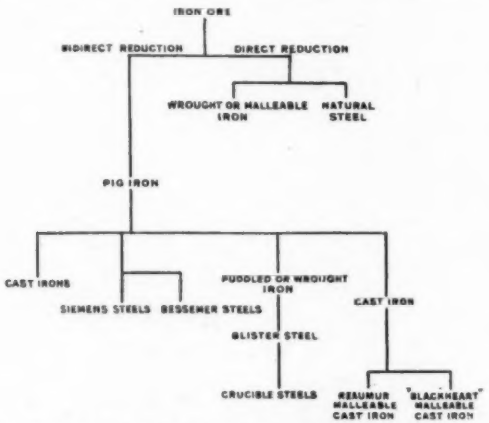


FIG. 7.—DIAGRAM ILLUSTRATING THE POSITION OF MALLEABLE CAST IRON IN THE METALLURGICAL WORLD.

During the last twenty or thirty years, the system of producing malleable similar to that produced by the American black heart has been developed. The author is at present actively engaged in producing both varieties, each having different qualities, and, therefore, applicable to its own sphere of utility. A fracture of each variety is shown in Fig. 6; that with the steely fracture is the original malleable cast iron as produced in Europe. The lower fractures are of what is known in America as the black heart casting. These two fractures are the result of the method of manufacture. The upper one, the "Reaumur," having the steely fracture, is obtained by the oxidation of the carbon contained in the original casting by hematite iron ore. The lower one, called "special" malleable, has been produced merely by changing the form of the carbon.

All malleable, as previously stated, consists of cast-iron of suitable composition annealed in various ways with the usual result of a malleable product. In the Reaumur process, as at present conducted, the castings are of such a composition that to render them malleable it is required to eliminate to a great extent the carbon originally present. Most of the malleable castings in Europe are of this type. The castings are packed in cast-iron boxes in hematite ore and raised to a heat at which the ore commences reaction with the carbon in the castings.

This action is the converse of the production of steel by cementation, in which process the carbon enters from the outside and gradually permeates the whole bar. In the elimination of the carbon exactly the contrary takes place, and the carbon is gradually eliminated from the outside first, so it follows that the interior of one of these castings has generally considerably more carbon than the outside. If successfully manufactured, however, the carbon in the centre is in such a condition as not to militate against its working capabilities.

As to the actual chemical reaction which takes place between the iron ore

and the carbon in the iron, it is not as yet sufficiently understood. However, it is known that gases easily diffuse through metals of the iron group in considerable quantities, and it is most likely that the action is somewhat dependent on the equation $CO_2 + C = 2CO$. In other words, the oxygen of the ore oxidises the first carbon to CO_2, and this carbon dioxide possibly combines with more carbon, forming CO, which in itself receives further oxygen from the iron ore, and so what might be called catalytic action takes place in which the CO is the carrier of the oxygen from the ore to the carbon contained in the interior of the castings. Such explanation seems as likely as any other at present put forward.

The photomicrograph, Fig. 14, shows the constitution of this metal as seen by the high power of the microscope. It consists chiefly of well laminated pearlite distributed through a ferritic matrix.

A few weeks ago the following abstract from a paper read before the Scandinavian Technical Society, regarding the strength of malleable castings as made in the Scandinavian Peninsular, was published in one of the technical papers :—

"The paper gives the tensile strength as between 40,000 to 50,000 lbs. per square inch. It has an elongation varying with different samples from 1 to 6 per cent., with a reduction of area at the breaking point of from $\frac{3}{4}$ to 3 per cent. It is thus seen that the ordinary grade of cast-iron having a tensile strength of 20,000 to 30,000 lbs. per square inch is but half as strong as malleable castings, though its compressive strength is much higher." etc.

Obviously, the malleable castings are of similar type to the Reaumur, and the above appears to be a fair statement of the mechanical tests which this type of malleable will give. The similarity between this material and steel is very much in evidence on comparing the microstructure, and it seems remarkable that, whilst the elongation and reduction of area of this type of casting are so low, it can not only be hammered and bent to a very considerable degree, but it will both harden, temper, and forge if properly made.

However, it must be confessed that whilst this material has great malleability, and great working powers, and is extremely useful for parts where wear and tear take place, it does not produce anything like the tests which the author has obtained by the development of the black-heart type. Attention was first seriously drawn to the development of this special malleable by the requirements of the British Admiralty. Their specification, by the way, is 18 tons to the square inch, a minimum elongation of $4\frac{1}{2}$ per cent. in 3 in., and a bending angle of at least 90 degrees over a 1-in. radius, the bar being 1-in. × $\frac{3}{8}$-in. in section. The variety of malleable casting known as American black-heart, has for its essential distinction the fact that the castings when cast are of such a composition that the carbon, which previously exists as combined carbon, is by annealing completely changed to that condition of carbon known as annealing carbon, to which Ledebur, the German metallurgist, gave the name of "Temper Carbon."

The author, in May, 1907, went thoroughly into this question of the change of the carbon, in a paper read before the Iron and Steel Institute, under the heading "Decomposition of Carbides," and he thinks this change can be best explained by reference to some of the photomicrographs given in that paper. These are six in number, Figs. 8 to 13, the first being the hard initial casting, whilst the last is the completely softened finished one. Fig. 8 gives the typical structure of cast-iron. All the carbon is in the combined state, the carbon of "supersaturation" being present as carbide Fe_3C, whilst the carbon of "saturation" is present as a compound roughly equivalent to $Fe_2 4C$. The castings are heated up during the annealing process to the temperature required (this, of course, differs with different makers), maintained for a varying period at this temperature, and are then cooled. The result is a casting in which the carbides are completely broken down into pure carbon and iron. Fig. 13 clearly illustrates this. Figs. 9, 10, 11, and 12, show the intermediate appearances of castings whilst the change is taking place.

Reference will now be briefly made to wrought iron, which is prepared by eliminating in the plastic condition, by means of oxides, the carbon and other impurities from pig-iron. The result is pure iron, with traces of sulphur, phosphorus, manganese, and a little carbon with a varying proportion of slag, the slag being mechanically contained in the iron. Wrought iron of the best make is as pure as iron can commercially be made, and everyone is familiar with its great ductility and malleability. Apart from iron, the only content of this material worth considering, is the involved

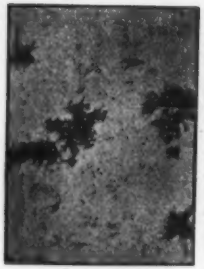


FIG. 8. — WHITE CAST IRON, SHOWING MICROSTRUCTURE OF THE TWO CARBIDES.

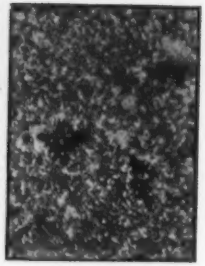


FIG. 9.

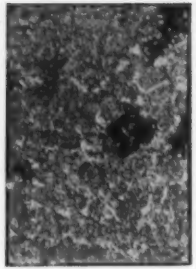


FIG. 10.

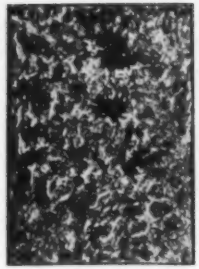


FIG. 11.

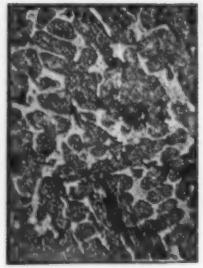


FIG. 12.

INTERMEDIATE STRUCTURES.

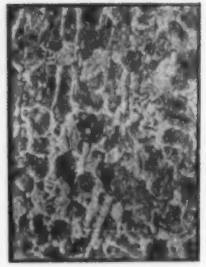


FIG. 13.—MICROSECTION OF THE WHITE IRON AFTER BEING CONVERTED INTO MALLEABLE CAST IRON, SHOWING THE STRUCTURE OF THE FREE CARBON.

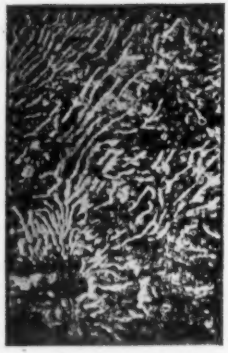


FIG. 14.—MICROSTRUCTURE OF REAUMUR MALLEABLE CAST IRON.

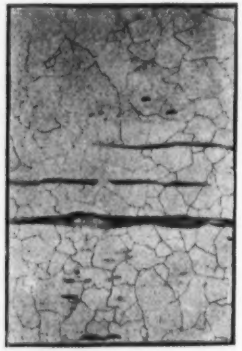


FIG. 15.—LONGITUDINAL SECTION OF SWEDISH WROUGHT IRON AS SEEN UNDER THE MICROSCOPE.

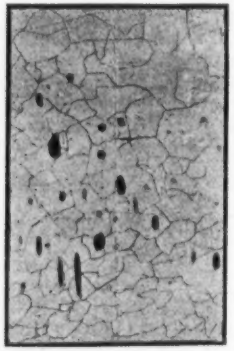


FIG. 16. — CROSS SECTION OF SWEDISH WROUGHT IRON AS SEEN UNDER THE MICROSCOPE.

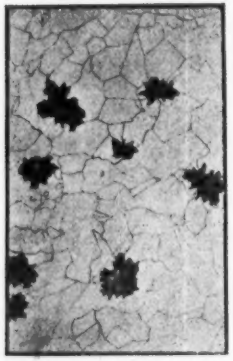


FIG. 17. — MICROSTRUCTURE OF SPECIAL MALLEABLE CAST IRON (KNOWN IN AMERICA AS BLACK HEART.)

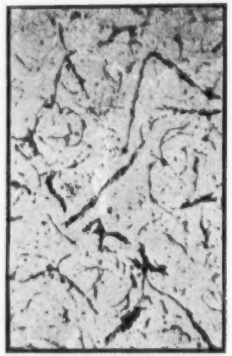


FIG. 18. — MICROSTRUCTURE OF GREY CAST IRON, SHOWING PLATES OF GRAPHITE.

slag which, during the rolling out of the iron, is drawn into threads running the length of the bar, and gives to wrought iron that peculiar fibrous nature of the fracture. Of course, there is no such thing really as fibre in iron products, as they are all crystalline.

Fig. 16 represents a section of wrought iron cut across the bar. Very little else is visible, but the crystals of ferrite, except a few dots of slag, which, of course, consist of the cross sections of the threads of slag before described. A longitudinal section of the bar which merely shows the crystalline structure of the pure iron along with a longitudinal section of the slag threads is shown in Fig. 15. It is obvious that this slag is practically of no detriment to the high properties of wrought iron. Wrought iron forgings, were it not for their high cost, are unquestionably excellent, and in working upon the subject of malleable cast-iron, wrought iron forging has been taken as a basis, and the endeavour has been made to produce in a malleable casting a structure as similar as possible.

The maximum stress in wrought iron is approximately 20 to 21 tons per square inch, and its elongation will vary from 20 to 30 per cent.; now, if against this the test previously given for malleable cast-iron is placed, namely, about 20 tons tensile strength with 1 to 5 per cent. elongation, it will be noticed that there remains considerable scope for improvement in the last-mentioned product.

Working on these lines, bars have been produced giving a tensile strength of 23 tons along with 19 per cent. elongation, 20.6 reduction of area, along with 180 degrees bending angle. Material such as the one of which the tests have just been given, and which is, of course, a casting and not a forging, is, one might almost say, a new product; the old tests for malleable cast-iron have been left far behind, and a material has been produced which has before it a much greater field than the original malleable cast-irons.

These special castings are very similar in structure to wrought iron. Microscopically they consist of ferrite, which is pure iron, with free carbon in such a form as will be obvious by the results obtained to be little more detrimental than the slag which is found in wrought iron; in fact, samples of wrought iron have been met which have not given much better results than the tests submitted in this paper. It will be well to conclude by asking whether malleable cast-iron with the properties and tests as stated is not entitled to a much higher position in the metallurgical world than it is given, and the author would venture to suggest that the "Nomenclature" Committee gave malleable cast-iron undeservedly short shrift when they stated that it merely lacked "the *extreme* brittleness of cast-iron."

The demand for malleable in this country as compared with that of the United States gives food for thought. The Americans are said to be producing over 90 per cent. of the world's production, Europe only producing the remaining 10 per cent. Here, in this country, a material giving tests considerably superior to those obtained in the States is produced, and yet this self-same material is excluded from many purposes for which in the States it would be allowed to be used.

The following table gives the comparative results which are now being obtained :—

Material.	M. S. Tons. Sq. in.	Elongated P. cent.	R. of A. P. cent.	Bending Angle.
Cast iron	12.0	Nil.	Nil.	Nil.
Old process malleable (Reaumur)	21 0	3.0	4.0	45°
American Blackheart	19.0	5.0	6.0	90°
Special malleable (Meadow Hall Ironworks) ...	23.0	14.0	17.0	180°
Admiralty Specification	18.0	4.5	—	90°

It will be noticed that in the special malleable, maximum stress is very high, whilst the ductility much surpasses that of any other malleable cast-iron. One obvious feature will be the ease with which this material passes Admiralty requirements.

THE SECRETARY OF THE B.F.A.

Mr. J. E. H. Allbut, Secretary of the British Foundrymen's Association, has removed from Sheepbridge House, Chesterfield, to Reservoir House, Butterley, Derby. We understand that Mr. Allbut has been appointed as engineer to the Butterley Company, Limited, Derby, having held his position at the Sheepbridge Coal and Iron Company's Works, at Chesterfield, as engineer and foundry manager for 10 years.

VANADIUM IN CAST IRON.

THE report of the first of a series of tests on the effects of vanadium on cast-iron, that are being conducted by Dr. Richard Moldenke, Secretary of the American Foundrymen's Society, has just been published in the "Transactions" of that Society. Referring to the cast-iron articles that might be benefited by the addition of vanadium, the wagon wheel is placed first, then the various kinds of rolls, alkali pots, pumps, etc., and also sections that are compelled to withstand repeated heavy strains, from direct tension and compression alternately, or great variations in temperature. The report is in part as follows:—

"In order to learn something of the effects of vanadium on cast-iron, a series of tests was conducted using melted scrap wagon wheels for white iron, and a good machinery pig-iron for a variety of grey iron. A ferro-vanadium carrying high carbon was selected because it melted at a lower temperature, and would also be cheaper for the foundryman. Varying proportions were added to a ladle full of molten metal, first in lump form, and as this did not give satisfaction with the small quantities of iron used at one time, the alloy was powdered before using. Inasmuch as vanadium, besides being a great strengthener, is also a powerful deoxidising agent, and the increase in strength obtained by its use might be attributed to the purification of the iron only, a further series of tests was included in which the ladles were first treated with 80 per cent. ferro-manganese in sufficient quantity to add 0.5 per cent. of manganese, and then the ferro-vanadium. To obtain some information on the deoxidising power of vanadium, a series of tests was also conducted with burnt metal. The test bars were of the regulation type as prescribed by the American Society for Testing Materials, namely, 1¼-in. round cast on end and in dried moulds. The test bars dumped when cold were only brushed and then broken transversely on a Riehle testing machine, having a capacity of 5,000 lbs. The test bars were carefully calipered and the modulus of rupture calculated. As a large number of tests were made, and many of the bars varied slightly in diameter from the standard, it made it difficult to compare effects by comparing the tables, and the breaking weights were all recalculated from the modulus of rupture back to the standard 1¼-in. diameter test bar. This, while not correct in its strictest sense—as cast-iron is not homogeneous and does not follow the rules applicable to steel—is nevertheless perfectly reliable for a very fair comparison showing the general effects of the addition of this alloy."

The first tests were conducted with burnt grey iron, such as burnt grate bars, stove iron, etc. Five test bars broke at an average of 1,310 lbs., and showed a deflection of 0.09 in., while the modulus of rupture was 25,500 lbs. per square inch. Three other bars of the same grade of iron to which 0.05 per cent. of lump vanadium was added, showed an average breaking strength of 2,220 lbs., a deflection of 0.10 per cent. and the modulus of rupture was increased to 43,380 lbs. per square inch. Three test bars made of burnt white iron showed an average breaking strength of 1,440 lbs., a deflection of 0.05 in., and the modulus of rupture was 28,170 lbs. per square inch. Twelve test bars made of the same iron, to which 0.50 per cent. of manganese and 0.05 per cent. of lump vanadium were added, showed an average breaking strength of 1,910 lbs., a deflection of 0.055 in., and an increase in the modulus of rupture to 37,400 lbs. per square inch. Another series of tests was made with melted pig-iron, to which no scrap was added, this iron being suitable for machinery castings. The first five bars to which no vanadium was added showed a breaking strength of 1,980 lbs., a deflection of 0.105 in., and the modulus of rupture was 38,680 lbs. per square inch. The analysis of one of these bars was as follows:—Silicon, 2.72 per cent.; sulphur, 0.065 per cent.; phosphorus, 0.668 per cent.; manganese, 0.54 per cent. By the addition of 0.05 per cent. of lump vanadium, the breaking strength was increased to 2,070 lbs., the deflection showed no increase, while the modulus of rupture was increased to 40,410 lbs. Nineteen test bars of this same grade of iron, to which 0.10 per cent. of lump vanadium was added, showed an average breaking strength of 2,200 lbs., a deflection of 0.115 in., and the modulus of rupture was 42,600 lbs. per square inch. By the addition of 0.15 per cent. of lump vanadium to this iron, four test bars showed an average breaking strength of 2,740 lbs., a deflection of 0.130 in., and a modulus of rupture of 53,750 lbs. per square inch. Three test bars of the same iron containing 0.50 per cent. of manganese and no vanadium, showed an average breaking strength of 1,970 lbs., a deflection of 0.1 in., and the modulus of rupture was

38,410 lbs. per square inch. By the addition of 0.05 per cent. of ground vanadium the average breaking strength of five bars of this same grade of iron was 1,980 lbs., deflection 0.1 in., and the modulus of rupture 38,700 lbs. Four bars containing 0.50 per cent. of manganese and 0.05 per cent. of ground vanadium, showed an average breaking strength of 2,130 lbs., deflection 0.1 in., and modulus of rupture, 41,780 lbs. Five bars containing 0.10 per cent. of ground vanadium showed an average breaking strength of 2,372 lbs., a deflection of 0.09 in., and a modulus of rupture of 46,320 lbs. Three bars containing 0.50 per cent. of manganese, and 0.10 per cent. of ground vanadium showed an average breaking strength of 2,530 lbs., deflection of 0.12 in., and a modulus of rupture of 49,590 lbs. Five bars containing 0.15 per cent. of ground vanadium showed an average breaking strength of 2,360 lbs., a deflection of 0.10 in., and modulus of rupture of 46,070 lbs.

Test bars cast from remelted scrap wagon wheels, containing no manganese, and to which no vanadium was added, broke at 1,470 lbs., showed a deflection of 0.05 in., and the modulus of rupture was 28,100 lbs. By the addition of 0.05 per cent. of lump vanadium to five bars of this same grade of iron, the breaking strength was increased to 2,190 lbs., the deflection remained unchanged, and the modulus of rupture increased to 41,570 lbs. By the addition of 0.15 per cent. of lump vanadium, the breaking strength was increased to 2,264 lbs., the deflection was 0.06 in., and the modulus of rupture 44,480 lbs. Four bars containing 0.50 per cent. of manganese and no vanadium, broke at 2,790 lbs., showed a deflection of 0.07 in., and the modulus of rupture was 54,570 lbs. Six bars containing 0.50 per cent. of manganese and 0.05 per cent. of ground vanadium, showed an average breaking strength of 2,970 lbs., a deflection of 0.09 in., and the modulus of rupture was increased to 58,040 lbs. The best results were obtained by the addition of 0.50 per cent. of manganese and 0.15 per cent. of ground vanadium, these bars having shown an average breaking strength of 3,920 lbs., a deflection 0.095 in., and a modulus of rupture of 76,650 lbs. The analysis of one of these bars was as follows:—Silicon, 0.50 per cent.; sulphur, 0.081 per cent.; phosphorus, 0.374 per cent.; manganese, 0.54 per cent.; vanadium, 0.22 per cent. One of these bars broke at 4,020 lbs., and had a modulus of rupture of 78,620 lbs.

Continuing, Dr. Moldenke says:—"The analyses were for the most part made on bars containing the powdered alloy, as these tests were the most satisfactory. The vanadium alloy used contained vanadium 14.67 per cent., carbon, 6.36 per cent., silicon, 0.18 per cent. While the vanadium content is comparatively low, this is a very good alloy for foundry purposes, as cast-iron is already high in carbon and the silicon is too small to materially effect the results. The best results with both manganese and vanadium show very little of the latter remaining. The results, however, are sufficient to strongly recommend the new alloy to the consideration of foundrymen. If but a part of the resistance to deterioration found by adding vanadium to steel should be proven by service trials to exist in cast-iron, then on the score of safety to human life alone, the metal should be in every wagon wheel. A still better method would be to use a more powerful deoxidiser than manganese, and to add the vanadium on top of it. To increase the breaking strength of a test bar from 2,000 to 2,500 lbs. for grey iron, and 1,500 to 3,900 lbs. for white iron, is sufficient to warrant further investigation on the part of every foundryman who has special problems in strength to master."

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THE PROPOSED COPPER AND BRASS INSTITUTE.

A MEETING of gentlemen interested in the manufacture and use of non-ferrous metals and their alloys was held at the Midland Hotel, Manchester, on Tuesday, March 10, to consider suggestions for the formation of a "Copper and Brass Institute," on the lines of the Iron and Steel Institute. Mr. W. H. Johnson, of the firm of Richard Johnson, Clapham & Morris, Manchester, was called to the chair, and amongst those present were Mr. L. D. Kirkpatrick Bedford; Mr. F. A. Lord (W. F. Dennis & Company, London); Mr. P. Longmuir, Sheffield; Messrs. A. and R. Johnson, Manchester; Mr. J. E. W. Burtenshaw, consulting engineer, Manchester; Mr. W. Rosenhain, of the National Physical Laboratory, London; Mr. J. T. Milton, of Lloyd's Register, London; Mr. E. G. Poppleton, London; Mr. Bengough, Liverpool University; Mr. J. Adamson, Hyde; Mr. R. Wheeler, of Monks, Hall & Company, Warrington; Mr. W. H. Robertson, Bedford;

Mr. J. Patchett, Wellington; Mr. G. H. Nisbett, of the British Insulated and Helsby Cables, Limited; Mr. T. G. Hirst, Leigh; Mr. W. H. Child, Salford; Mr. Harry Jacobs, London; Mr. J. A. Bayliss, Birmingham; Mr. E. C. Watkins, St. Helens; Mr. L. Sumner, Broughton Copper Company; Mr. O. Langenbacn, London; Mr. J. Baer, London; Mr. H. P. Hall, of Platt Bros. & Company, Oldham; Mr. J. E. Stead, Middlesbrough; Professor Carpenter, Manchester University; and others.

The CHAIRMAN, in introducng the business, said that about six weeks ago a letter by Mr. Robertson, of Bedford, appeared in all of the engineering papers suggesting the formation of an institute for brass and copper manufacturers. (See FOUNDRY TRADE JOURNAL, March issue.) That letter attracted attention, and a private meeting held at the office of a firm of Manchester solicitors led to discussion, and the discovery of a widely-spread feeling that such an institute would be desirable. He had received letters from a number of eminent firms, including Messrs. Thomas Bolton & Sons, the King's Norton Metal Company, Messrs. Richard Johnson & Nephew, Mr. F. Smith, Messrs. Isaac Storey & Sons, Messrs. Hopkinson (Huddersfield), Messrs. H. Barth & Sons, Messrs. Crossley Brothers, Limited, Messrs. Vickers, Sons & Maxim, Limited, Messrs. Henry Wiggin & Company, Limited (Birmingham), Messrs. Vivian & Sons (Swansea), Messrs. Muntz & Company (Birmingham), and others, expressing a sympathetic interest in the movement. The objects of the proposed institute, the Chairman went on to say, were, first, to advance our knowledge of the non-ferrous metals and their alloys, more especially copper, zinc, tin, aluminium, lead, nickel, gold, silver, and platinum. Secondly, the publication twice a year of a volume of abstracts of papers and books on metallurgical subjects likely to interest members. It must be a comprehensive bibliography of the practical and scientific work on non-ferrous metals of each year, both at home and abroad. This would cost money, but would be of immense value. Thirdly, the institute would afford means of communication between members. Fourthly, they would have meetings to discuss practical and scientific subjects relating to the manufacture and working of metals. To this he attached special importance. Success depended on the freedom with which heads of departments, and the juniors, were permitted to come forward with papers for discussion.

PROFESSOR CARPENTER (Manchester University), said that so far as scientific workers in the field of metals were concerned, an institution such as was proposed would be warmly welcomed. He had received about 40 replies from scientific and other metallurgists to a circular sent out, and he might say at once that they were, without exception, favourable, though some were very distinctly qualified. Professor Turner, of Birmingham, wrote :—"I see a difficulty in connection with a Copper and Brass Institute, owing to the fact that all the important manufacturers prohibit their employés from reading papers, and very few will allow visitors to go over their works." Professor Baer (Edinburgh) was of opinion that the formation of such an institute would be of great advantage. Dr. Seligmann, of the British Aluminium Company, wrote :—"I most heartily welcome your new departure, which will, I feel certain, stimulate research, which is very badly wanted, and facilitate the interchange of ideas between non-ferrous workers." One important point, Professor Carpenter said, emerged from these letters, which could not be too early dealt with—it was the question of trade secrets. So long as an attitude of secrecy was maintaned it would be impossible to form an institute—at any rate one which would attract scientific workers.

MR BAYLISS (King's Norton) moved a resolution affirming the desirableness of founding a Society dealing with the non-ferrous metals and their alloys.

MR. H. PLATT HALL (director of Platt Brothers & Company, Oldham), seconded the resolution.

Some discussion followed, in which the objects aimed at were recommended by MR. STEAD (Middlesbrough), MR. MILTON (London), MR. ROSENHAIN (London), MR. LANGENBACH, and others. Ultimately, in deference to the wish of several gentlemen that before the Institute is definitely formed fuller opportunity should be given for gentlemen (particularly in London and Birmingham) who might be interested in it to be consulted, a resolution in the following terms was unanimously agreed to, on the motion of MR. ROSENHAIN, seconded by MR. NISBETT :—"That while this meeting is favourable to the formation of an Institute, it is considered desirable before entering on a definite constitution of the Institute that manufacturers, large users, consulting engineers, and scientists should be further approached, and that a later meeting should be called, in London, for a final decision as

to the feasibility of forming an Institute."

It was further resolved that an influential Committee should be formed, embracing members of the largest copper smelters and consumers, to canvass the trade in support of the Institute. Among the visitors present the following also handed in their names as willing to serve on the Committee:—Mr. Stead, Mr. Jacobs, Mr. Bayliss, Mr. Poppleton, Mr. P. Longmuir, Mr. Rosenhain, Mr. Harbord (London), Mr. G. W. Nisbett, Mr. J. T. Milton, Col. Patchett, Mr Lord, Mr. E. Story, Professor Turner (Birmingham), Professor Gowland, Mr. Rhead (Manchester), Professor Howe (U.S.A.).

Professor Carpenter was requested to act as Secretary to the Committee.

It was decided to hold a further meetin London on June 10, at 2.30 p.m., at which the Committee will report progress, the place of meeting to be arranged by the Secretary.

The CHAIRMAN said it was earnestly desired that manufacturers and others in the United States, on the Continent of Europe, the British Colonies, and Japan, should be interested in the formation of the Institute, and act in co-operation with them.

The meeting closed with a vote of thanks to Mr. Johnson for presiding.

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BRITISH FOUNDRYMEN'S ASSOCIATION.

Birmingham Branch.

A MEETING of the Birmingham Branch of the British Foundrymen's Association was held at the Technical School, Suffolk Street, on Saturday, February 22, to hear a paper by Mr. W. J. Stocker on "Foundry Costing." Mr. R. Buchanan presided.

MR. STOCKER, who is an accountant in connection with a large Birmingham engineering firm, dealt with the subject from the practical point of view, exhibiting facsimile methods of book-keeping for the provision of permanent records. He pointed out that the needs of different foundries greatly varied, but a foundry connected with engineering works should be treated as an independent concern, and, if possible, a complete set of books should be kept, showing capital, expenditure, etc., also stock-books giving details of all materials received by foundries, and recording the giving out of materials during the month, the requirements being debited to a monthly working account. The cost department is a most essential one, requiring to be constantly referred to in all business transactions, the lack of a proper system being responsible for numerous failures.

In all cases of new work the foundry manager or foreman should be consulted, their experience enabling them to quote for castings either from a drawing or pattern. The duties of costs-clerks should be to prepare costs, and not use statistics to trip up the several departments on the basis of what was done on a previous occasion; and statistics of productive cost should be produced as readily for the departmental heads as for the managing-director.

The speaker then proceeded to deal in detail with various books, comprising order-book, foundry cards, pattern records, pattern cards, labour tables, cupola sheets, etc. Mr. Stocker made a strong point that sheets should be filled in showing the actual time required for each order. The cupola record should tabulate all raw material taken out during the month, totalled and debited on working output, and everything should be weighed into the cupola. A record sheet should show the amount of good castings produced per month, and, finally, working expenses should be arrived at by taking analysis of the current month's salaries, rent, lighting, laboratory charge, and general establishment charges being furnished by accountant's department. The charges should be worked out in proportion at so much per ton of the castings produced.

The CHAIRMAN called attention to the great value of the example shown on the black-board, and pointed out that systems would naturally require to be adapted to various branches of the trade.

MR. GROVER dealt in some detail with various systems of book-keeping, laying particular stress on the importance of recording expenses that were "dead," in the sense that they were not productive. The card and the chart system were both very valuable.

MR. F. J. COOK remarked that a good many foundries did this kind of work in a very haphazard sort of way. It was not so much a question of recording as of getting the information, especially in a large establishment where a number of jobs were running concurrently. It was difficult to allot the precise amount of time for each job. There was a great amount of difference, for example, in the amount of dressing various castings required.

Mr. Poole said he had found cost-recording so difficult and complex that he had come to the conclusion that it was almost impossible to do it properly, but he was certain that many competitors were very reckless in the way they quoted, and it was almost impossible to compete against firms of that description. Many of such competitions were the result of either ignorance or roguery.

Mr. Holder thought that it would assist the foundry manager very much in making quotations if his employer would furnish him in advance the amount to be added in respect of standing charges.

Mr. R. Mason said there were many complaints that manufacturers did not receive as much assistance as they might from the foundry foremen, and one in particular told him that he never could get a straightforward definite answer from his manager. Of course, that was wrong. The foundryman must give something definite, but on the other hand he ought to have what assistance could be obtained from the cost-office. The office and the foundry should work hand-in-hand instead of trying to trip each other up.

The Chairman mentioned several examples he knew of firms which had failed through the lack of proper cost-keeping. There were a great many unbusinesslike people in foundry work, for whom business-like people had to suffer. The former was no friend of anybody's, except possibly the man who bought from him. In a jobbing shop it was a most complex matter to get out the true cost of an individual casting. He knew one firm in which workmen told the costs-clerk anything that suited them, running time from one job into another, on the ground that it was not well to let the office know too much. The result was that the books containing such records were not worth the paper they were written on. He was afraid foundrymen were somewhat prone to cover up their tracks for fear of ulterior consequences, either immediate or remote.

On the other hand, there was a tendency not to tell too much to the men. The cost-office was a most indispensable adjunct to the foundry, and it was no advantage to anybody that costs should not be known. It was quite a wrong idea to regard the cost-clerk as a non-producer. Some firms did not know until their eyes were opened by the state of the banking account that they had been trading at a loss. A manufacturer could really do better without technical knowledge than without business knowledge. Many foundries could not tell what their standing charges were, and he imagined that even when they were known the office could hardly be expected to tell them to the foundry manager.

Mr. Stocker briefly replied on the discussion, and was accorded a vote of thanks, which he acknowledged.

Birmingham Foundry Visit.

A large contingent of the Birmingham Branch of the Association on February 8, paid a visit to the works of the Midland Electric Supply Company, Limited, at Ocker Hill. This is a concern founded six years ago to supply power to private users, and its customers extend over an area of 90 square miles. The power is used for lighting, traction, machining, iron works, foundries, and other purposes. There are nine sub-stations. The production is 36,000 units per day, and there is an aggregate horse-power of 10,000. One of the consuming firms takes 800 kw. of power. The engines are what are known as Ferranti alternators, and there are two Willans & Robinson turbines with a capacity of 1,800-kw. each. The eight boilers are of the Babcock type, and the switchboard is of the Ferranti description.

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FOUNDRY WASTE.*

By Dr. Richard Moldenke, Watchung, N. J.

In these times of serious industrial depression perhaps no subject should receive greater attention than the prevention of waste.

Buried Wealth in Foundries.

In passing through many foundries I have often been tempted, on seeing the end of a lump of iron stick out from behind a lot of rubbish in a corner, to take a silver dollar from my pocket and ask the foundry foreman to throw it in there also. The point is generally quickly understood. While in Pittsburg in my earlier days I usually had some 50 lbs. of dynamite on hand for use in blowing up salamanders as they were unearthed in the foundry in making changes in the plant. The foundry foreman working in the interests of his employers can save quite a lot of waste in iron in the course of a year. Every foundry of any account

* A paper read at the convention of the Chicago Foundry Foremen's Association, March 5, 1908.

should have an electro-magnetic separator for the shot made, as well as a slag barrel for the same purpose. I have known these separators to pay for themselves in three months, and saw one some time ago set up on the dumping pile of the foundry waste, which was paying handsomely in iron recovered.

Who has not gone through the matter of saving the unburned portion of the cores used in the foundry and profited thereby? How many foundrymen will allow their foremen to experiment with binders and mixtures until the proper one is found giving the greatest satisfaction at the least cost? Yet unless this is done for every new set of conditions arising there is a positive waste.

Economical Arrangement and Equipment.

To take up the subject systematically we must first start with the general layout. If the means of communication in the foundry or manufacturing establishment are not at once simple and effective, no time should be lost to make them so, even if walls have to be cut with a general rearrangement of the departments. This can be accomplished slowly and without disturbing conditions of work too seriously. Next, proper light and ventilation should be provided. There should be no dark corners nor too convenient gates. An electric light plant of ample capacity is a good investment. The use of torches and dirty windows is waste. Heavy smoke induces cessation of work that has money value. Means should be provided to carry iron to every point in the foundry without breaking down men. In the larger shops small jib cranes save money in allowing a moulder to handle his own work without disturbing every one near him. All this comes under the head of equipment, which makes the first cost of the foundry higher, but saves labour, and thereby money. We could add to this air-equipment for chipping, moulding, cleaning, and what not.

Moulding Sand and Moulding Machines.

Probably no foundry foreman is entirely satisfied with his sand. He would always like to have it better. The trouble is that we do not yet know enough about the physical constitution of a moulding sand to give it the proper treatment. The ideal conditions are those in which any amount of pounding will not prevent proper venting, and yet the sand must be able to bond properly. At the same time it must be refractory to a high degree and stand repeated applications of melted metal without spoiling too much of it.

The greatest elimination of foundry waste ever brought about was through the introduction of the moulding machine. Perfect as these machines are becoming, 50 years from now we will think those of to-day crude. Think for a moment how the success of a moulding machine is tied up with the sand used on it. Correct this element of uncertainty and a further step in the direction of the elimination of waste will have been taken.

Loss of Castings through Ignorance.

The next greatest waste in the foundry is the loss through ignorance of the moulder's art. The discount and time cards speak for this. What is badly needed is instruction day in and day out to the men engaged in moulding, coremaking, and other occupations requiring skill. The foreman has his hands full with the larger questions. He cannot go into the small details, and yet from neglect of these the waste is great. The old custom of piling up the moulder's bad castings for inspection at dinner time is a good one, but still better is an interview with him at his bench or floor by an expert specially engaged to do this under the foreman's direction. How many of our larger shops have this in operation?

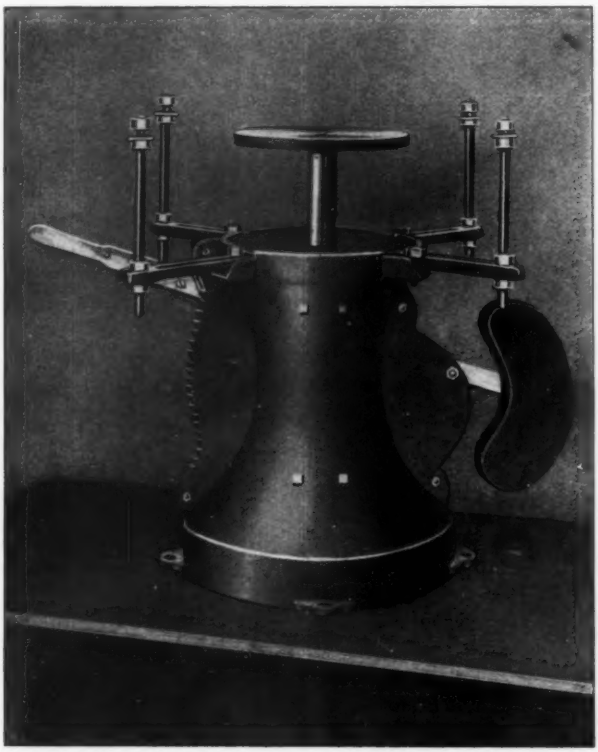
In the larger classes of work, the loss of pieces is small, but the time taken for moulding is great. How often this could be cut down effectively by proper appliances. For small castings the usual custom is to pay by the piece, with perhaps a premium attached for extra efficiency. But how many bad castings are made which could have been saved by proper instruction, not to speak of the greater output per flask, if the mixing and melting of the metal were made more perfect.

One of the most notable improvements I have seen in recent years is the desire on the part of foundry foremen and superintendents to acquire every scrap of information it is possible to get hold of. The foreman of to-day is just as able to calculate out a mixture as the chemist. He may not yet understand the action of the elements completely, but with the aid of night schools, by reading and asking questions, he will soon get all that he requires.

Waste in Melting.

Taking more particularly the metallurgical end of the foundry, we find a

direct waste in improper melting methods. How often have I found a 2,000-lb. charge consisting of the usual pig-irons and scrap, and a 500-ladle to tap into. And then there was worry about porous or otherwise defective castings. To come right down to a question of daily practice: Inasmuch as the bed of a cupola coke charge is fixed by the desired capacity to hold iron, and by the location of the melting zone (only the coke above the tuyeres being effective, and the rest only so much filling to cool the iron rather than heat it), why is the first charge of iron used made so heavy? The melting of this lowers the coke bed seriously, and the second charge of coke does not bring it back to the place it had originally. Now as the iron and the coke come down in the succeeding charges this level may be raised again, even above the original bed, with the result that often the last coke charges must be reduced to get proper results. A much better practice would seem to be to make all the iron charges small, the first as well as the last, dividing the coke so that the proper ratio is kept for the whole run. This gives the smallest variation of the coke bed, and, as I have always found, the most uniform iron. After all, it would seem that our old foundrymen were not so far off when they first put in their bed of anthracite, then charged so many shovels of scrap, so many pigs, then some more anthracite, then metal again, all in very small quantities. They did make castings that are our admiration for quality to-day, though we consider the melting method crude. I will only say that with even large diameter cupolas, where the work has to stand water pres-



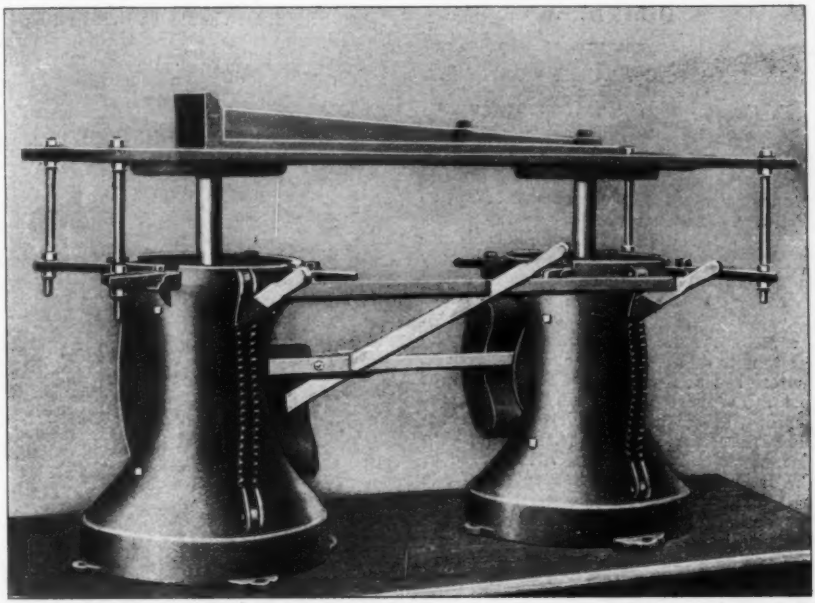
"DUPLEX" STRIPPING PLATE MOULDING MACHINE.

sure tests, and hence must be perfectly uniform in character, besides correct in composition, the above method of very small charges of 500 lbs. of metal, and the corresponding coke directly from the bed-up gives excellent results where the old big charge method fails.

Now in cupola practice coke saving is in most cases waste. I strongly deprecate the attempt to get high melting ratios. The few pounds of coke saved always mean trouble in other directions. As long as the first iron shows from 7 to 10 minutes after the wind is put on, and the iron does not come too slow or hot at the end, it is better not to tamper with the coke ratio of the cupola in question. Similarly, to attempt to save 25 cents a ton in the mixture, and increase the percentage of discards or the cost of machinery, is a waste. Buying high silicon iron to mix plough points may work all right, but usually means waste until handled right. Far better, if hard and soft irons are to be made in a day's run, to use high grade ferro-silicon in the ladle.

THE "DUPLEX" STRIPPING PLATE MOULDING MACHINE.

THIS machine is entirely self-contained and can be placed in any corner of the foundry, no belting, shafting, or expensive fixing being required. The machine can be operated by a boy, as no skilled knowledge is needed for its use. The cheapest method of work is to use snap flasks, as one flask will do for any quantity of moulds which simply require a loose shield slipping on for casting. The arms which hold the stripping plate up can be extended to suit the size of box proposed to be used, and this is a special feature of the machine, it being designed to take the place of those which only take one size of box. Two machines can be worked together for long work. Engine pedestals 12 in. by 4 in. by 7 in. are being made on it, and fire-bars 3 ft. long in a box 4 ft. by 12 in. Wood, metal, or plaster patterns can be used, as there is no risk from drawing or rapping as in hand moulding.



"DUPLEX" MACHINES WORKING IN CONJUNCTION FOR A LONG PATTERN.

It is claimed that the use of this machine secures true jointing, true drawing of patterns, and no mending of moulds. It is suited for malleable and general ironfounders and brassfounders for repeat work. The castings which can be made on it depend largely on the ingenuity of the foreman.

The maker is Mr. Arthur Green, Whittington Moor, Chesterfield, to whom we are indebted for these particulars.

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CORRESPONDENCE AND QUERIES.

CASTING GAS ENGINE PISTONS.

To the Editor of the FOUNDRY TRADE JOURNAL.

In reply to "Piston," the causes of defective castings may be found in the improper selection of pig-iron and scrap, as well as in the character of the fuel. The manner of moulding will also largely influence the final result, and the way ladles are lined and dried has a great deal more to do with the final appearance of a casting than is commonly supposed. In all cases it is imperative that the molten iron should be covered with a material which will keep the oxygen of the atmosphere from coming in contact therewith, and for this purpose fine charcoal is second to none, as it prevents the assimilation of oxygen on the surface of the metal. If this is not prevented the iron oxide will again be released, and the action of foreign particles upon the oxide will begin anew. Thus the keeping of the fluid iron covered has for its purpose not only the prevention of cooling, but also the guarding against affiliation with the oxygen of the atmosphere. The most expeditious method of moulding gas-engine pistons is shown in the accompanying illustration. This method is generally adopted in the making of caps, covers, step-pulleys, motor ends, etc., and lends itself admirably to the making of pistons. The core takes the place of the top moulding box, and is self-centreing; that portion of the core which closes the mould must be at least 2 in. thick, and 2 in. larger all round than the casting. The print should have a large taper; this makes it simpler both for moulding and coring up. It is important in this method of moulding that the core fits its print, and that no blacking is put on that portion of the core which goes into the print, or the portion which forms the print. That part of the casting shown at A, Fig. 1, is in excess of the required casting, the usual allowance being about 2 in. This allows any dirt, etc., that may gather in the mould to rise in that portion which is cut off in the machine shop. The core, as shown at B, Fig. 1, which forms the hole for the connecting rod pin should have at least $\frac{3}{16}$ of an inch clearance on both sides to allow it to pass freely into the mould, without chipping the core or the mould, and which, when the casting is machined on its outer surface, will cut through. It is essential that the moulds should be dried and well vented; run them and rise them as shown. These should be $\frac{3}{8}$ in. thick, and $1\frac{1}{2}$ in. broad. When dry the mould should be placed on an empty box part, the core fixed in its position in the mould, and then fastened down with two cramps, Fig. 2, for which on the upper edge of

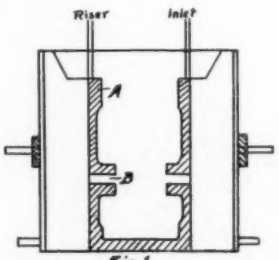


Fig 1.

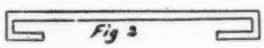


Fig 2

the moulding box there should be four lugs or flanges for the cramps to clip on to. These should be of suffieient strength to resist the fluid strain while the mould is being poured. The runner and riser should now be made up, and the whole lifted bodily on to a perfectly flat drag part, made to match the other part, and which could be rammed up on a flat plate. This should be at least 3 in. deep, with suitable number of bars in, and dried. The two parts having been cottered together, it is then ready for pouring, and if clean work is to be the order, and not the exception, a shutter over the inlet should be used until the runner head is full of metal. With regard to a suitable

moulding machine, I should say the Pridmore machine would be most adapted to this class of article. Taking it for granted that the above method and suggestions are carefully attended to, and that the metal is hot enough, and of the right composition, you should experience no difficulty in rapidly and economically producing first-class castings.—C. E. A.

To the Editor of the FOUNDRY TRADE JOURNAL.

SIR,—Having seen "Piston's" enquiry in your February issue, and Mr. Garrick's reply in the following number, might I suggest an alternative method. I have made a considerable number of these castings, and experienced the same difficulty as "Piston" has, which I overcame in the following manner:—The piston was moulded on its side, having a nicely-made pattern in halves for the purpose. The boxes should have three holes in one end (half in cope and drag), one at each side for runner and riser and one in centre to allow for core-iron and vent. The core-iron should project through the end of core and be screwed, and the vent should be led off round the core-iron. Before ramming the mould, place a piece of hoop-iron (bent the shape of core print), on the print about an inch away from the casting, so as to give core a firm rest, and when ramming see that the print end of pattern is close against the top end of box, not forgetting to lay the runner stick through one of the side-holes to bottom of casting, with the riser through the other hole to the top of casting. Take care to have a small runner and large riser. When the mould is ready, place the core in position with core-iron passing through centre hole in end of box, then put a washer over the end of core-iron and screw the nut on so as to tighten the core against the end of the box. Then close the top, clamping the two parts together, turn the whole up on end, so that core is supported by the nut at top, and cast in that position. This position of casting allows the gases from the core (which I consider the real cause of the trouble) to escape freely and at once, and to become ignited by the metal being poured through the top, directly there is sufficient gas to light. The only difference between "Piston's" case and my own is the size of the castings, mine being smaller.

Yours, etc.,

C. A. E. MARTIN.

To the Editor of the FOUNDRY TRADE JOURNAL.

SIR,—I have not the original query before me, but referring to a letter in last month's issue, damp sand, in my experience, has never been a factor in spongy castings; all that I ever knew come of damp sand was a blow up, which gave ample evidence on the spot that no hope of a good casting, where such takes place, need for a moment be entertained.

I note the complaint is "blown or spongy;" by this I take it there is doubt as to the case. This need not be, as experience can at once discover the difference.

If it be the former, then there must be glaziness somewhere in the immediate region of the bad part, and if it be of the latter it must come from one or both sources, viz., kish (which is just another term for dirt), or shrinkage.

After all, it might turn out a question of "position." It might be with this casting as with many others where every point in detail of moulding is correct, even to the metal, but which if cast in the wrong position, a "scrap" instead of a casting would inevitably result. This idea of good, clean scrap is in these days becoming the convenient phrase for bad casting. I do not mean by this that one can turn Middlesbrough iron into the best Yorkshire iron, but where only rust is the complaint of any mixture, which can never get beyond the surface, it seems to me such apologies for bad castings only reveal a weakness somewhere that should not exist amongst responsible foundrymen.

Yours, etc.,

"MOULDER."

To the Editor of the FOUNDRY TRADE JOURNAL.

SIR,—I have had several years experience in gas engine castings, locomotive, portable, horizontal, and vertical engine castings, and desire to say with reference to the query in your last issue, the best method of running pistons for all classes of engines is first to have very hot metal, rather close metal, not too open, in order to wear well. It is important to have the moulding sand not too damp. It should be made in all black, moulding sand, lined fine sand. The gits or runners should be all round the pattern. Small sprays, say about six sprays (I have made, I might say, a

hundred in my time), cut the runner all round the top part, the sprays at the bottom. This should give success.

Yours, etc.,
J. W. WILLOWS.

MELTING FINE TURNINGS.

To the Editor of the FOUNDRY TRADE JOURNAL.

SIR,—In reply to the complaint in last month's issue by "Reader from the Beginning," in which he states I again fail to meet his question, but does not say in what way my suggestion failed, what I tried to point out to him was, that the chief factor in each processes was the guarding against affiliation with the oxygen of the atmosphere, and clearly described the best method of doing so. He also says that nearly the whole of my reply dealt with the melting and mixing of alloys of aluminium with other metals. Such was not the case. What I endeavoured to bring to his notice was that the affinity of zinc for iron was very weak, and beyond the fact that ordinarily the zinc of commerce contains 1 or 2 per cent. of iron, I am still of the opinion that it is extremely difficult to form an alloy of zinc and iron directly. In his February letter he quotes the tendency of aluminium to oxidise, yet apparently he is not aware that zinc also has a great affinity for oxygen, fine turnings of which, if placed in an open wire-work basket and freely exposed to the atmosphere will take fire, and burn with great vivacity, giving out an intense light if only set fire to with a lighted match. Knowing the decided tendency of these metals to oxidise, the losses, therefore, from remelting are considerable, especially if the divisions of the scrap are fine, and so marked is this oxidation that it is all but unprofitable to remelt turnings, borings, etc., unless they are baled as tightly as possible. Small quantities of the metal can be baled by the hand-cabbaging pot, and large quantities by the hydraulic cabbaging press. The melting should be conducted slowly, and avoid exposure to the atmosphere.

Yours, etc.,
"C. E. A."

To the Editor of the FOUNDRY TRADE JOURNAL.

SIR,—"A Reader from the Beginning" says: "I am, however, fairly well posted in all the ordinary methods of melting and mixing," etc. This, to most people, will doubtless be apparent, but if he had added to this statement his recipe or formula in detail, others with a somewhat similar experience to himself might even yet be tempted to try and help him out of his difficulties. To some it must be quite a new experience to find that metals which have previously produced first-class castings, cannot again be remelted to produce similar work, at least, when a little new metal is added.

Yours, etc.,
"A READER SINCE ITS INCEPTION."

To the Editor of the FOUNDRY TRADE JOURNAL.

SIR,—*Re* the difficulty of melting fine turnings. My advice is not to attempt to remelt or alloy with virgin material, such would be a royal road to a defective result; deterioration of your new material would be inevitable. Your only safe and economic way would be to dispose of them even at a sacrifice, and you would profit eventually by absence of trouble.

Yours, etc.,
"S. F."

CONVERTING BOILER FLUE INTO CUPOLA.

To the Editor of the FOUNDRY TRADE JOURNAL.

SIR,—"Flue," with regard to converting boiler flue into a cupola, does not state whether the angle iron rings are interior or exterior. If they are interior, it is advisable that they should be removed. The following dimensions, etc., should meet his requirements:—Thickness of lining throughout, 4½ in., making the internal diameter 29 in. from base to charging door; charging door, 26 in. high, by 22 in. wide; height, base to charging door, 12 ft. 6 in., and 3 ft. from base to three tuyeres 4½ in. diameter; diameter of blast fan, 40 in., r.p.m. 2,500. It is advisable to have an air belt at least 40 per cent. larger in sectional area than the combined tuyere area. The air should pass into the belt at a tangent, and blow round the belt, thereby avoiding the impinging of the air on a flat surface. The tuyeres should have sight-holes covered with a door on the air-belt, so that a bar can be passed through to remove slag or other obstruction from time to time during the melting operation. If you want to make long runs of melting, it is essential that you have a slag hole, on the opposite side to which the air enters the

belt, and the top of this should be level with the bottom of the tuyeres.

Yours, etc.,
"C. E. A."

To the Editor of the FOUNDRY TRADE JOURNAL.

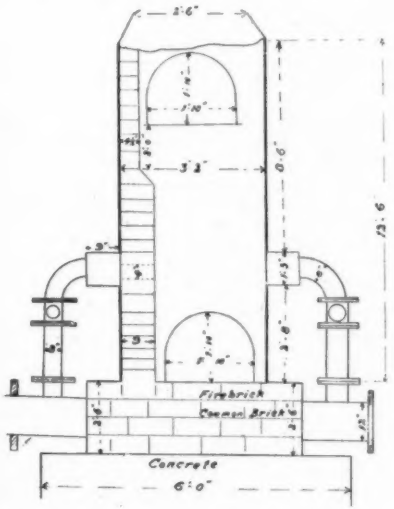
SIR,—If "Flue" will turn to page 222, February 4, 1905, issue of "The Ironmonger," he will there find an article by the writer entitled, "Starting a Small Foundry," and which is illustrated with a cupola, and to a nearness of the dimensions asked for by the above inquirer in every detail.

Along with this he will find the necessary instructions for charging and working the cupola.

Yours, etc.,
"W. R."

To the Editor of the FOUNDRY TRADE JOURNAL.

SIR,—I have enclosed sketch and a few particulars for converting boiler flue into a cupola capable of melting from 2 tons



to 50 cwts. per hour. I should advise air-belt having four tuyeres 4 in. diameter; air pressure from blower, 8 to 12 ozs. I have placed charging door as high as possible without encroaching into tapered portion of flue. Any further information required I shall be glad to supply.

Yours, etc.,
"TUBAL CAIN."

CASTING NAME PLATES IN BRASS.

To the Editor of the FOUNDRY TRADE JOURNAL.

IN reply to "Surface," the castings you are desirous of making, I take it, are used for imprinting decorative designs, etc. These are generally cast in hard bronze, and should the castings be rough, the cost of the finished article is greatly enhanced because of the costly tool work. It is requisite, therefore, that the working surfaces of such castings be as fine and smooth as possible, and to secure this it is necessary to print back such moulds. The following method I have used with success:—For facing-sand take 3 parts new Mansfield sand and 1 part old moulding sand, and to every 15 parts add 1 part of bean flour; damp with water until a little more damp than heap-sand, then pass through a ¼-in. riddle, sift this facing on to the pattern through a fine sieve, fill up the box with floor-sand, and ram soft. When the whole of the mould is rammed up, remove the cope, gently rap the pattern to loosen it, after which replace the cope, and roll the mould over. The drag being now uppermost is carefully lifted off the pattern, the pattern resting upon the cope; this must on no account be disturbed, or an imperfect reprint will be produced. Scrutinise the pattern closely to see if it has torn the sand anywhere; if so, spray the mould with very thin gum-water, and build up the broken places, making them a little full, and firm enough to hang when the drag is inverted. Spray again with gum-water, this time thoroughly, and dust on the printing sand, composed of new sand, burnt in the furnace and afterwards pounded fine in a mortar, and to 8 parts of this add 1 part of flour; place in a bag of close texture, and dust on to the mould as required. Blow out any dust that may have gathered in excess, then thoroughly dust lycopodium powder, or partomol over both the impression and the joint of the mould. The drag is again closed on to the pattern and re-rammed, using the butt-end of the rammer. The mould being rammed soft in the first place, this now brings it to the proper density. The drag is now again lifted off. The impression should be examined for any broken portion; these must be built up, and dusted with a little lycopodium. Close the mould again, and gently ram over the defective spot. A perfect impression having been obtained, the pattern is removed, and the mould finished in the usual way, with the exception that it is better not

to flour it. The mould must be surface-dried before casting. In all cases where there are delicate projections, common-sense will suggest that it is safest to dry, and the gum-water may be freely used as it strengthens the impression. For such work a charcoal fire is the best and the easiest to use. Take a piece of the bottom of an old ¼ in. riddle, prop horizontally 3 in. from the floor, and over this put an iron ring that will hold about two handfuls of charcoal. A piece of 3-in. rainwater pipe is as good as anything. Place a little charcoal inside the ring, then a bright, hot coke, and more charcoal; a good hot fire is the result. The oven is made by placing two or three box-parts, the same size as used for the mould, over the fire. Place the cope or drag-part impression down over the top box of the oven; the fire is then underneath, so the mould gets the benefit of all the heat, and is quickly and thoroughly surface-dried.—C.E.A.

LYCOPODIUM.

To the Editor of the FOUNDRY TRADE JOURNAL.

IN reply to "W. H.," most of the lycopodium of commerce comes from Russia, and is merely the pollen of the club moss, and is purchasable from the chemists at about 4d. per oz. Its value as a parting medium lies in the fact that it will not mix with water, and while it is very inflammable, it does not boil under heat and roughen the casting. You will find partomol an almost perfect substitute for lycopodium, and is obtainable from Messrs. J. W. Jackman & Company, Limited, Caxton House, S.W. When you commence with partomol, always use clean bags, and never use the bags for any other purpose.—C.E.A.

CHILLS FOR ANTIFRICTION METAL.

To the Editor of the FOUNDRY TRADE JOURNAL.

SIR,—Can you tell us any maker's name for chills such as are used by anti-friction metal-founders for quickly casting ingots exact to weight, and with nice, clean raised lettering thereon.

Yours, etc.,
"N. H. C."

PHOSPHOR-BRONZE.

To the Editor of the FOUNDRY TRADE JOURNAL.

SIR,—We have some heavy phosphor-bronze rings 3 ft. 6 in. diameter, 4½ in. square, to make, which are required to stand a high tensile strain and be fairly hard; but in adding tin for hardness we find it lowers the tensile qualities. Kindly give us a good mixture, with the tensile strength, and state how it should be poured.

Yours, etc.,
"E. M. B."

FLUX FOR MILD STEEL CASTINGS.

To the Editor of the FOUNDRY TRADE JOURNAL.

SIR,—Can you let us know of a good flux to be used in melting steel for mild steel castings. Our great trouble is that we cannot get the metal sufficiently liquid for pouring.

Yours, etc.,
"B. S. S."

REFRACTORY MATERIALS.

AT a recent meeting of the Sheffield Society of Engineers and Metallurgists, Mr. Cosmo Johns gave a lecture on "Refractory Materials—A *Resumé* of Recent Progress in the Study of the Silicon Compounds with Reference to the Properties of the Acidic Refractory Materials."

The lecturer briefly described the new products of the electric furnace, carborundum and siloxicon, and their value as refractories, and gave some interesting details of their manufacture. It was explained how the older methods of research, such as a chemical analysis of the various clays or raw material, and an occasional trial to determine the resistance to high temperatures, had failed to throw any light upon the laws that govern the action of the various substances found in the raw material used by makers of fire-resisting materials.

The lecturer reviewed the chief substances in fire-clays, gannister and the silica brick, and dealt with them first singly and then in pairs. Silica as the predominant compound was described in its many forms. The curious fact was that it changed its mineral form and acquired new properties, among which a much higher melting point was the most important. The bearing of this on the mode of manufacture of the silica brick was pointed out. Silica in its many forms would seem to be nearly as complex as steel.

The behaviour of the oxides of iron at high temperatures came under notice, and the absorption of oxide of iron by the silica at steel-melting temperature was commented on.

STAFFORDSHIRE FOUNDRYMEN'S LECTURE.

On March 26 a lecture was given before the Wolverhampton Engineering Society by Mr. F. G. King, manager of the malleable and steel department of Messrs. Harper & Company, Willenhall. The Society includes in its programme every year at least two papers of metallurgical interest. Mr. King outlined the general process of the manufacture of malleable iron in the British trade, as distinguished from the American system known as the "Black Heart," giving a full description and analysis of the brands of pig-iron used, detailing the mode of melting, gating, and running castings, and the annealing process. Specimens of work such as car wheels, steam engine pistons, intricate filigree work, motor car parts, etc., were shown. Tests were also added in respect of tensile strength and elongation both by Lloyd's and by the Admiralty Inspectors, and showed exceptional quality. A discussion followed, in which Messrs. Buchanan, Wright, and others took part.

The Birmingham Branch was represented at the meeting by Messrs. R. Buchanan, F. J. Cook, R. Mason, Bullock, and P. Nickless.

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CORE OVEN PRACTICE.

At the meeting of the Pittsburg Foundrymen's Association, recently, Mr. Benj. Fuller read a paper on "Core Oven Practice." Referring to core ovens for light work, he said that the portable oven constructed of cast and sheet iron, with hinged shelves which swing open with the door, and have following doors or dampers to close off the openings while the shelf is exposed, thus conserving the heat, is, when properly fitted up, a more efficient oven than many built at double the cost. A saving of fuel and an increase in efficiency can be effected by enclosing the sides and back in a galvanised iron or sheet metal casing, allowing a space of two or more inches between the oven and casing, which is packed with asbestos, scrap mica, mineral wool, or some other non-conductor.

The fire boxes are usually too small as furnished, and give better results if increased in size by raising the walls three or more inches. He also suggested the use of gas coke in preference to cupola or furnace coke, as a quicker and hotter fire will result.

Where a large number of medium-size cores are to be made, the permanent oven built with fire brick walls, iron frame, and having tiers of draw shelves operating on roller bearings with following doors or dampers to close off the openings when the shelves are exposed was recommended. With coke as a fuel the fire box should be built at one end and placed below the floor line. Furnace coke is preferred, as the fire box is of sufficient size to hold a body of coke large enough to ensure an intense heat with proper draft.

Mr. Fuller then described the large ovens installed at the Cleveland works of the Westinghouse Electric and Manufacturing Company. The fire boxes of these ovens are unusually large, being 4½ ft. long, 3½ ft. wide, and 4 ft. high. The openings into the stack are large enough to take care of the gas and steam arising when firing, and are fitted with dampers which can be operated from the outside. Each oven is 10 ft. high, 13 ft. wide, and 24 ft. deep, and is provided with two standard gauge tracks. Each track accommodates two trucks, making four trucks per oven, or 16 for the four ovens. All of the ovens are fired from one pit, the fuel descending from above through chutes. A depressed track extends across the front of the ovens, on which is operated a transfer buggy which permits of the placing of a truck in any of the ovens. An iron platform has been built over these ovens, on which is stored coke for fuel, sand, dried cores, etc.

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What is claimed to be the first electrical furnace for the production of steel in Belgium is approaching completion at the works of the Société des Acieries Liegeoises, at Bressoux. It is of the Kjellin-Roechling type.

A meeting was held recently of the creditors of William Glover & Sons, Limited, engineers and ironfounders, Warwick and Birmingham. The liquidator stated that the firm was established 70 years ago, and now, through want of capital, keen competition, and continued losses for four years, they had to resort to voluntary winding up. The loss on last year's trading was nearly £6,000. The assets altogether ought to amount to £28,665. There ought to be a dividend for ordinary creditors of possibly 15s. in the £. The matter was left in the hands of the liquidator.

LIST OF NEW INVENTIONS.

Specially compiled for the FOUNDRY TRADE JOURNAL by MR. GEORGE BARKER, Fellow of the Chartered Institute of Patent Agents, Consulting Engineer and Chartered Patent Agent, 77, Colmore Row, BIRMINGHAM.

3,413. RICHARD CREMER. Improvement in the construction of plugs for foundry ladles.

3,924. JOHN JONES & SONS, LIMITED, and JOHN JONES. Improvements in apparatus of machinery for the production of bricks, blocks, pipes, sand, or other moulds, or the like, of various shapes and sections.

4,159. APLERBECKER HUTTE, BRUGMANN, WEYLAND & COMPANY. Improvements in apparatus for tipping foundry ladles.

4,234. MALCUS HOLMQUIST. Improvements in core-forming machines.

4,424. FRANK WILLIAM HARBORD. Improvements in drying blast for metallurgical furnaces.

5,139. JAMES EDWIN YORK. Improved method and apparatus for solidifying ingots.

5,192. WM. ARCHBOLD HARTLEY. Improvements in the manufacture of cast steel armour plates, ammunition tubes, gun shields, and other articles.

5,232. GEO. HY. DAWSON and ARTHUR CLARKE. Improvements in connection with tumbler ingot moulds.

13,421. W. KINGTON, Falkirk. A machine for casting metals by the use of metal moulds or pattern plates.

This invention relates to the casting of metals in metal moulds and in accordance therewith a machine is constructed provided with metal moulds or pattern plates in which large plots of small and medium-sized sand moulding.

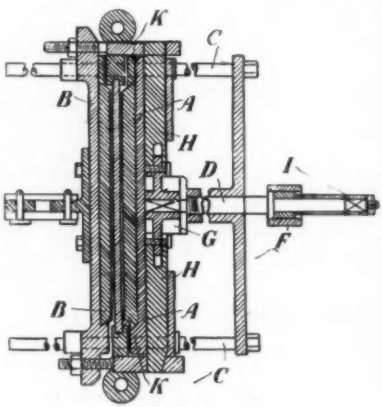
As shown in the drawing, which is a section, the machine is provided with two or three pattern plates A, which are temporarily fixed by being slipped down between the bevelled adjusting strips K, to two movable plates A and B, so that the pattern plates can be removed and other pattern plates be inserted when required.

The movable plates A and B, form part of the machine proper, and are capable of being slid backward and forward on the parallel rods C, which are four in number, and are secured to two ends or standards.

The movement of the plates A and B is effected by means of two sliding rods D and E, which are actuated by a double acting lever F.

The rod D is capable of rotation through a right angle, and serves to operate a cam G, which actuates a locking mechanism H, and thus holds the plate firmly together during the pouring of the metal.

The lever F, and cam handle I, are preferably at the same end of the machine, so that the operations of unlocking and withdrawing the plates to



enable the operator to remove the casting can be performed simultaneously. The bevelled strips K may be adjusted and secured by screws.

The machine constructed on these lines is intended to be of special use for repetition work, as large numbers of castings may be made in permanent moulds, and thus uniformity in the castings is greatly increased.

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AMERICAN FOUNDRY EXHIBIT. — The second annual foundry exhibit and convention of the Chicago Foundry Foremen's Association was held on March 5 to 7. Visiting foundrymen, in addition to the members of the Association, were given opportunity to see actual demonstrations of various moulding machines and foundry appliances, and to enjoy an interesting programme of addresses.

TRADE TALK.

MESSRS. E. HORNBY & COMPANY, engineers, Manchester, are retiring from business.

MR. T J. GREEN, of Worksop, has acquired the Potter Street Iron Works in that town.

MESSRS. DUDGEON & GRAY, consulting engineers, have removed to 89, Aldgate London, E.C.

MESSRS. MILLAR, DENNIS & COMPANY, engineers, have removed to Thornton Road, Bradford.

MR. T. FILDES, has removed his business to Thornton Street Iron and Copper Works, Manchester.

MESSRS. C. A. PARSONS & COMPANY have removed their London office to 8, Victoria Street, S.W.

THE EAGLE OIL ENGINE COMPANY have acquired a part of the works of W. Glover & Sons, Limited, Warwick.

MESSRS. WILDERS BROTHERS, have disposed of their Albion Engineering Works to Messrs. J. F. Moakes & F. G. Doust.

A DISSOLUTION of partnership is notified in connection with Messrs. H. O. Andrews and J. E. Hackett, engineers, of Liverpool.

MESSRS. GEIPEL & LANGE, Vulcan Works, St. Thomas' Street, London, S.E., have altered the style of their firm to Geipel & Company.

BULLERS, LIMITED, engineers and ironfounders, Tipton, have removed their London establishment to 6, Laurence Pountney Hill, London, E.C.

THE INTERNATIONAL TOOL AND SUPPLY COMPANY, Birmingham, have decided to relinquish the engineers' machine-tool department of their business.

MESSRS. J. P. HALL & COMPANY, of Oldham, notify us that Messrs. Loxley & Company, of Leeds, are no longer in any way connected with their firm.

A FIRE broke out recently at the London Road Iron Works, Glasgow of D. Stewart & Company (1902), Limited, doing damage estimated at about £7,000.

MARKHAM & COMPANY, LIMITED, of Chesterfield, are supplying Earle's Shipbuilding and Engineering Company, Limited, with two 100-ton swing cranes.

MESSRS. W. PRATCHITT, J. PRATCHITT, and W. M. PRATCHITT, engineers and founders, Carlisle, have dissolved partnership, so far as regards Mr. W. Pratchitt.

THE LOCOMOTIVE AND MACHINE COMPANY OF MONTREAL, LIMITED, 26, Victoria Street, S.W., have altered their name to the Montreal Locomotive Works, Limited.

THE BIRMINGHAM SMALL ARMS COMPANY, LIMITED, have appointed Mr. W. S. Davis, of Sheffield, as their agent for that district for the sale of engineers' small tools.

THE MIRFIELD ENGINEERING COMPANY, LIMITED, of Mirfield, Yorks, have acquired the whole of the patterns, goodwill etc., of the late Joseph Bernay's centrifugal pumps.

MR. F. J. TUCKER, late of Wm. Menzies & Company, has established himself in business as F. J. Tucker & Company, manufacturers' agents, 65, Fenchurch Street, London, E.C.

MESSRS. H. RODGERS & COMPANY, Caxton House, Paternoster Square, London, E.C., have been appointed London agents for H. F. Harvey & Sons, Limited, Zoar Works, Wolverhampton.

R. Y. PICKERING & COMPANY, LIMITED, of Wishaw, have lately been erecting branch works at Beighton, Sheffield, which are intended chiefly for undertaking repairs, etc., to wagons.

MR. J. SHEPHERD (of Messrs. J. Abernethy & Company, engineers), read an interesting paper on "The Making of Iron Castings" to the members of the Aberdeen Association of Civil Engineers recently.

MESSRS. HADFIELD'S "Era" steel recently underwent a severe test by the military authorities. A 6-in. gun-shield was selected, and although attacked with 6-in. common and 6-in. standard-capped A.P. shot, remained intact.

MESSRS. HARDY SELIGMANN & COMPANY, Billiter Buildings, 22, Billiter Street, E.C., have been appointed by Messrs. Thyssen & Company, machine engineers, Mülheim, as their export agents for the United Kingdom and Colonies.

MESSRS. HEBB & COMPANY have opened offices at 56, Buckingham Gate, Victoria Street, Westminster, S.W., as engineers, retaining the services of Mr. S. B. B. Hebb, an expert on the subject of condensing and water-cooling in connection with steam plants, turbines, etc.

APPLEBYS, LIMITED, are erecting in the structure covering in the fitting-out basin of Messrs. Yarrow & Company at Scotstoun, a 50-ton overhead travelling crane, which will have a span of 93 ft., one of the largest span overhead cranes of this capacity yet erected in this country.

PERSONAL.

THE late Sir Henry Whatley Tyler left estate of the gross value of £162,139.

THE late Mr. Alfred Baldwin, M.P., left estate of the value of £198,693 gross.

MR. A. MARRIOTT has been taken into partnership by Messrs. Marriott & Graham, boilermakers, Govan.

MR. J. GREGORY, representative of the Carnforth Hematite Iron Company, has resigned, but will retain his seat on the board.

PERSONAL estate of the value of £22,384 has been left by the late Mr. T. Pickard, chairman of the Birmingham Railway Carriage and Wagon Company.

THE late Mr. Joseph Evans, of Joseph Evans & Sons, Limited, Culwell Foundry, Heath Town, Wolverhampton, left estate valued at £176,141 gross.

MR. W. D. DIXON, general manager of the Ormesby Iron Works, of Cochrane & Company, Limited, has retired after 38½ years' service.

THE gross value of the estate of the late Mr. Allan Haigh, managing director of Allan Haigh & Company, Limited, brassfounders, Halifax, is £6,027.

MR. J. EATON-SHORE, works manager for Messrs. Willans & Robinson, has resigned, in order to take up a similar post for Messrs. Siemens Brothers, of Stafford.

MR. T. BEELEY, of T. Beeley & Son, Limited, Hyde Junction Iron Works, Hyde, near Manchester, has been re-elected vice-chairman of the Cheshire County Council.

MR. H. F. WRIGHT, J.P., of the Butterley Company, has resigned the office of Deputy Grand Provincial Master of the Provincial Grand Lodge of Derbyshire Freemasons.

MR. G. A. LONGDEN, late managing director of Cammell, Laird & Company's Sheffield Works, has been appointed to a similar position with Henry Bessemer & Company, Limited.

COLONEL J. R. WRIGHT has been elected chairman of Baldwins, Limited, in place of the late Mr. Alfred Baldwin, M.P., and Mr. Stanley-Baldwin, M.P., has been elected vice-chairman.

MR. A. COMBE, having resigned his directorship of Fairburn, Lawson, Combe, Barbour, Limited, has been succeeded by Mr. R. Ardill. Mr. T. Barbour has also been elected a director of the company.

MR. W. GRAHAM, general manager of Messrs. Bailey's Barry and Newport Engineering Works, has been made a J.P. for Glamorgan, as also has Mr. H. A. Burgess, manager of Messrs. Vivian & Sons' Copper Works, Taibach.

—o—

NEW COMPANIES.

SAMSON STEEL BALLS, LIMITED.—Capital £1,000 in £1 shares (500 preference).

THE BRITISH WELDING COMPANY, LIMITED.—Capital £120,000. Registered office: 2, St. Andrew Square, Edinburgh.

LONDON REFINING AND METALLURGICAL WORKS, LIMITED.—Capital £2,000. Registered office: 32, Clerkenwell Road, E.C.

THOMAS LEMON & SONS (CARDIFF), LIMITED.—Capital £3,000, to acquire the engineering business of T. Lemon & Sons, The Hayes, Cardiff.

WILLIAM SUDWORTH & COMPANY, LIMITED.—Capital £2,000, to take over the business of William Sudworth & Company, engineers, Blackstone Street, Nottingham.

S. P. (SUCHOSTAWER PATENTS) SYNDICATE, LIMITED.—Capital £6,500, to carry on the business of iron and brass founders, etc. Registered office: 88, Fenchurch Street, E.C.

J. S. DOIG & COMPANY (FLEETWOOD ENGINEERING WORKS), LIMITED.—Capital £10,000, to acquire the Strathtay Iron Works, Fleetwood. Registered office: 33, North Albert Street, Fleetwood.

NEW LOWCA ENGINEERING COMPANY, LIMITED.—Capital £25,000, to acquire the business of the Lowca Engineering Company, Limited. Registered office: Lowca, near Whitehaven, Cumberland.

JOHN WILLIAMS (BIRMINGHAM SAND) LIMITED.—Capital £5,000, to acquire the business of J. G. Williams, Icknield Square Wharf, Birmingham, and to carry on the business of manufacturers of and dealers in charcoal, mineral, and plumbago blacking, etc.

BENNETT, FARREN & COMPANY, LIMITED.—Capital £5,000, to take over the business of engineers, etc., carried on at the Devonshire Works, Egerton Street, Sheffield, by J. F. Bennett and R. Farren.

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30 TON.

JAMES EVANS & CO., BRITANNIA WORKS,

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BLACKFRIARS, MANCHESTER.

OBITUARY.

MR. J. T. WEIGHT, engineer, of St. Andrew's, Bristol.

MR. T. EVANS, for many years cashier to the Rhymney Iron Company, aged 78 years.

MR. H. BARUGH, assistant secretary to Bolckow, Vaughan & Company, Limited, Middlesbrough.

MR. R. D. BURNIE, managing director of the Swansea Wagon Company, Limited, aged 66 years.

MR. E. BARRACLOUGH, confidential secretary to Mr. E. Carlisle, the general manager of Cammell, Laird & Company, Limited.

MR. J. T. DARBY, sole partner of the firm of J. T Darby & Company, engineers and boilermakers, Bootle, Lancs., at the age of 48 years.

SIR JOHN SHEARER, chairman of the firm of John Shearer & Sons, Limited, engineers and shipbuilders, Glasgow, after an operation for appendicitis; aged 65 years.

MR. W. WILLIAMS, chairman and managing director of D. & F. Taylor, and a director of John & Edwin Wright, Limited, and W. & T. Avery, Limited. He was 65 years of age.

MR. L. H. TAYLOR, honorary president of the Taylor Iron and Steel Company, U.S.A., which company since 1891 have manufactured manganese steel under exclusive patent rights in America secured from Hadfield's Steel Foundry Company, Limited, of Sheffield.

MR. GEORGE DAWSON, J.P., managing director of Newton, Chambers & Company, Limited, of Thorncliffe, Sheffield, in his seventy-seventh year. He had charge of the iron works branch of the company, and successfully carried out a number of large constructional works in various parts of the world.

DR. HENRY CLIFTON SORBY, the well-known scientist, died at Sheffield, on March 9, in his 81st year. In 1857 he became a Fellow of the Royal Society, and in 1869 the Geological Society, of which he was elected President in 1879, awarded him the Wollaston Gold Medal. In 1872 he received the Boerheave medal of the Dutch Society of Sciences, and the Queen's Gold Medal of the Royal Society fell to him two years later. In 1875 he was elected the President of the Royal Microscopical Society, and in 1876 he was also made the President of the Mineralogical Society. Dr. Sorby's life and work are further commented on in the editorial notes.

—o—

MESSRS. J. S. HODGSON and C. F. HODGSON, gas engine manufacturers, etc., Rotherham, Yorks, notify a dissolution of partnership.

MESSRS. JAMES ALLAN, SEN., & SON, ironfounders, etc., Glasgow, have re-opened their works as a private limited company. Arrangements have been made with the trustee in the sequestrated estate to take over the entire business, including plant, patterns, goodwill, etc.

MESSRS. T. DAVIES & SON, Railway Iron Works, West Gorton, Manchester, in addition to the manufacture of foundry cupolas, which they have carried on for many years, have now completed the erection of plant for the manufacture of modern foundry ladles, of which they intend to make a speciality.

Ganister, Cupola Blocks, Fire Bricks,
Fire Clay.
Silica Bricks, Tuyeres, Stoppers, Nozzles, &c.
Steel Moulders' Composition, Silica Cement.

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The following, selected from numerous letters, are eminent testimony as to the quality of our celebrated "A.A.A." Coppee Foundry Coke, carefully selected, and despatched in sheeted wagons.

From PECKETT & SONS, Bristol.

Bristol, October 25th, 1904.

We have been using your Selected Foundry Coke for some considerable time.

We have pleasure in stating that we are very pleased with it, as we find we get sounder and cleaner castings, more free from blow-holes and other defects, than we formerly did.

From MOUNTFORT PHILLIPS & Co., Llantrissant.

Llantrissant. October 25th, 1904.

In reference to the Foundry Coke you have been supplying us with for the last six months, we have very great pleasure in letting you know that it has given every satisfaction, and that our Works Manager and Workmen give it the highest praise.

Elders Navigation Collieries, LTD. Cardiff.

PRICES OF METALS.

The following table shows the approximate latest prices and position of stocks of metals during the past two years :—

Metals.	1907-8.	1906-7.
Iron—Scotch pig warrants ... ton	*56 9	*61 0
—Middlesbro' warrants ... ton	51/1½	53 5
—W.C. M/nos Bessemer ... ... ton	82 0	78 6
—Stock, Scotch, March 31 ... tons	1,028	4,300
Copper—Chili bars, G.M.B. ... ... ton	£59 5 0	£92 2 6
—Stock, Europe & afloat... ... tons	23,265	15,007
Tin—English ingots ton	£142 10 0	£187 0 0
—Straits ... ton	£141 15 0	£182 15 0
—Stock, Ldn. Hind and afloat ... tons	15,755	12,921
Lead—English pig ton	£14 12 6	£19 12 6
Spelter—Ord. Silesian ... ... ton	£21 5 0	£26 0 0
Quicksilver—(75lb.) bottle	£8 4 6	£7 0 0
Antimony—Regulus ... ... ton	£34 0 0	£100 0 0-£103 0 0

*Settlement price.

Castings.

In the Cleveland district the following are the nominal rates current for castings :—

	£ s. d.		£ s. d.
Columns (plain)	6 15 0	to	7 0 0
Pipes, 1½ to 2½ in.	5 2 6	to	5 7 6
,, 3 to 4 in.	4 15 0	to	5 5 0
,, 5 to 8 in.	4 12 6	to	4 15 0
,, 10 to 16 in.	4 12 6	to	4 15 0
,, 18 to 24 in....	4 12 6	to	4 15 0
Chairs	3 12 6	to	3 15 0
Floor plates (open sand)	3 0 0	to	3 2 6

Scrap.

The quotations for scrap, subject to market fluctuations, are as follows:—Heavy wrought (mixed), £2 7s. 0d.; light wrought, £1 1s. 0d.; heavy cast, £2 6s. 0d.; all per ton f.o.b., London. Copper (clean), £56 0s. 0d.; brass (clean), £43 0s. 0d.; lead (usual draft), £13 10s. 0d.; tea lead, £11 15s. 0d.; zinc, £17 5s. 0d.; all per ton delivered merchant's yard.

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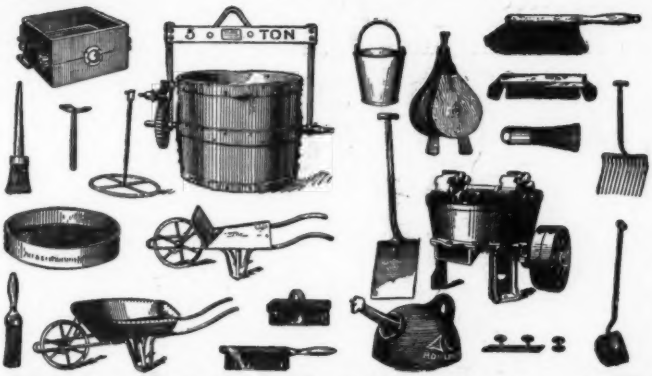

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Manufacturers of all

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Composition Black Lead,

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Ladles, Cupolas, Fire Bricks, Gannister, Stone Flux, Loam and Sand Mills, Casting Cleaners, Studs, Chaplets, Pipe Nails, Sprigs, Brushes, Wire Brushes, Core Ropes, Bellows, Buckets, Spades, Forks, Riddles, Sieves, Barrows, &c.

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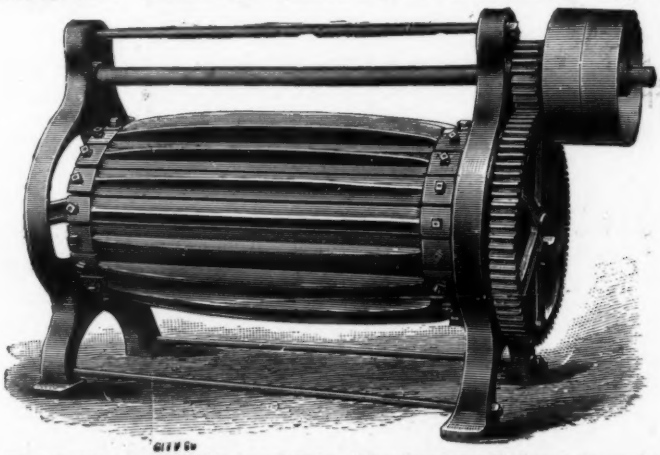

These Machines are invaluable for a Foundry, doing a larger amount of work of a superior quality, in a much shorter time than can be done by hand, without skilled labour.

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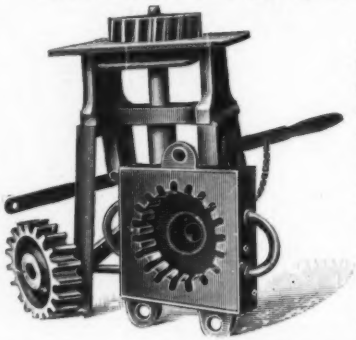

The advantages of these Machines over the ordinary methods of Moulding are so great that no foundry which has any call for repetition work should be without them. The saving in labour alone in many cases reaches as much as 75 per cent., and the castings are much more accurate, being exact duplicate of each other, and with scarcely any fin at the joint. No skilled labour is required, it is simply necessary to shovel in the sand and ram it, lower the lever and remove the Moulding Box. There is no rapping of the Pattern required, no patching nor sponging, and the time occupied is but a fraction of that required in the ordinary manner of moulding.

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FOREMAN (Patternmaker) wants position as such; thoroughly qualified in all branches of the trade.—Address, Box 210.

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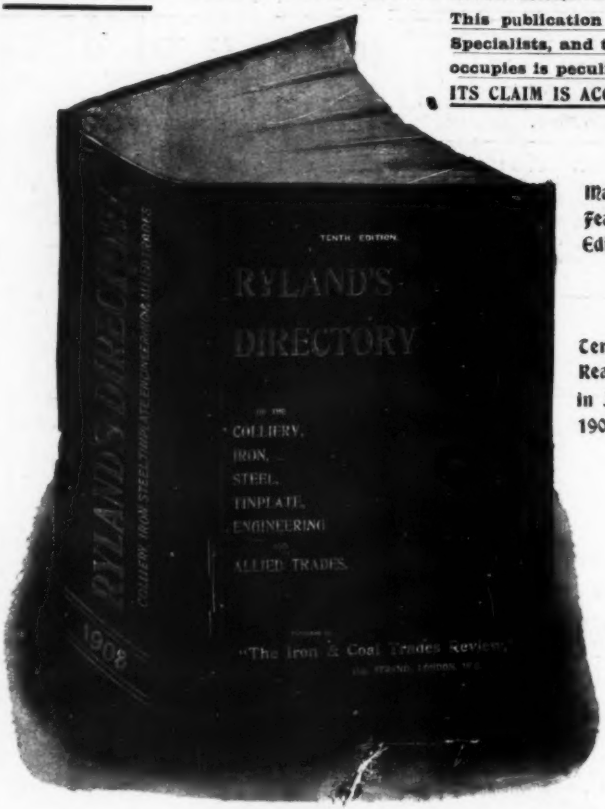

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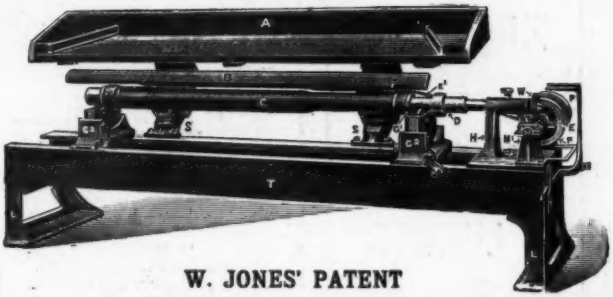

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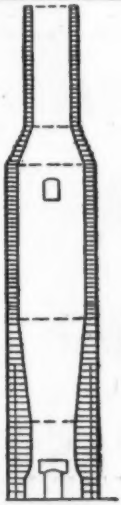

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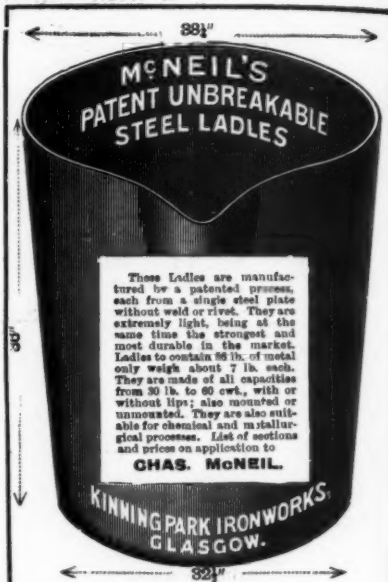
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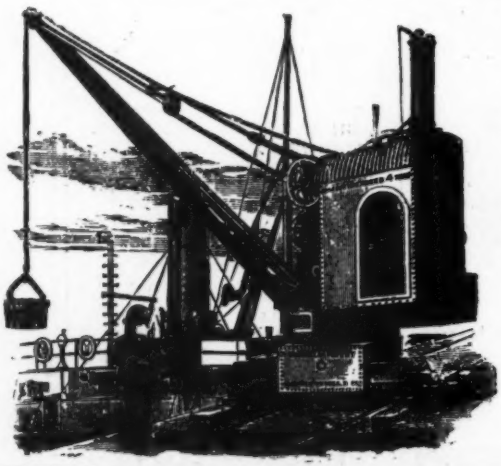

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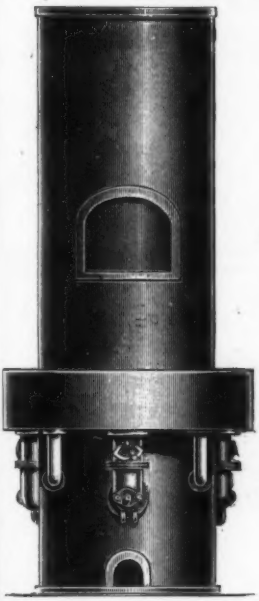

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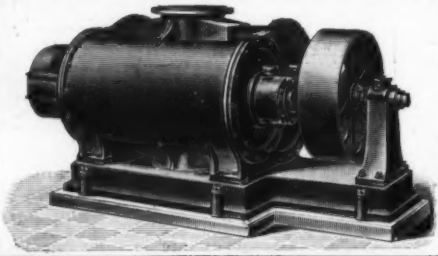

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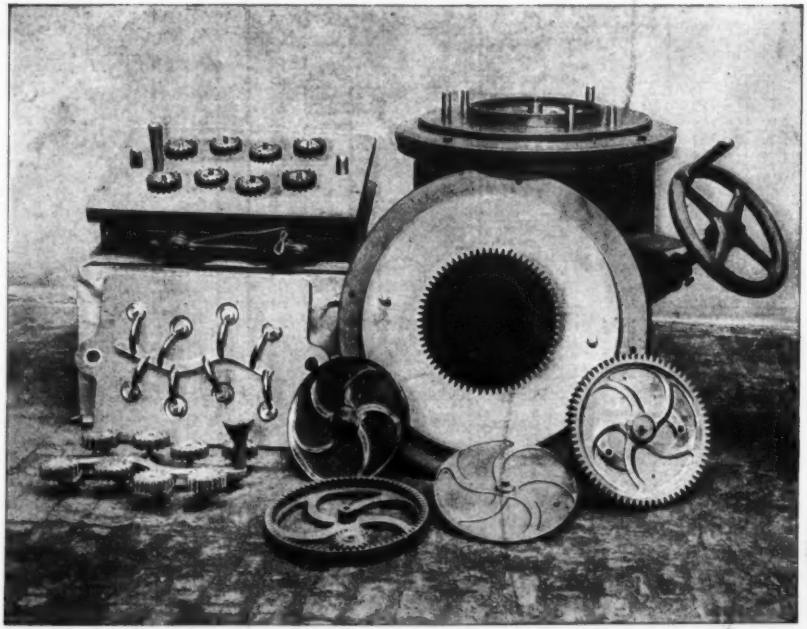

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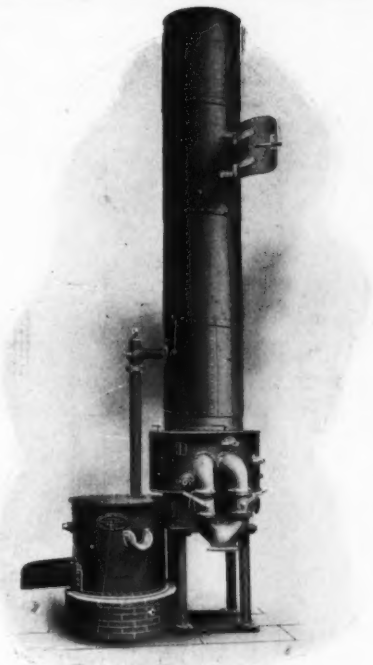

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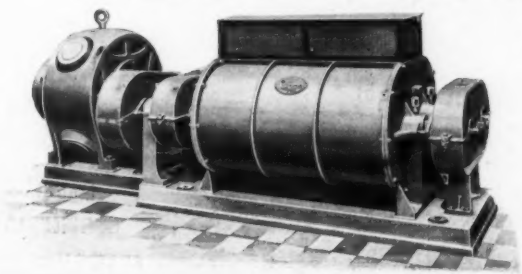

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